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ABSTRACT

The research in this report was conducted to assess the cognitive impact of a simulation game designed to teach selected geographic data about wind and ocean currents to fifth graders. A two-group, post-test research design was used. A random procedure was used to assign 185 students to two treatment groups. The sample was divided by sex, ranked and paired by reading scores and randomly assigned to treatment. One group was given the simulation game while the other was given a programmed text having similar cognitive objectives. Treatments were administered followed by a posttest and a delayed posttest. On the immediate, posttest no significant differences occurred on the mean scores between the two treatment groups and between the sexes. On the delayed posttest, the game scored significantly higher than the programmed instruction group. The data produced evidence that the game group, while not learning more geographic information than the programmed group, retained more over a period of time. (Author/WS)

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Final Report

Project No. 2-D-060
Grant No. OEG-4-72-0022

Everett T. Keach, Jr.
David A. Pierfy
Social Science Education
Fain Hall
University of Georgia
Athens, Georgia 30601

THE EFFECTS OF A SIMULATION GAME ON LEARNING OF GEOGRAPHIC INFORMATION AT THE FIFTH GRADE LEVEL

September 30, 1972

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Office of Education

National Center for Educational Research and Development
(Regional Research Program)

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ABSTRACT

Purpose

The major purpose of this research was to assess the cognitive impact of a simulation game designed to teach selected geographic data about wind and ocean currents.

Methodology

The investigators constructed a simulation game and a programmed text having similar cognitive objectives. A two-group, posttest only research design was used. A stratified random procedure was used to assign 185 students to the two treatment groups. The sample was divided by sex, ranked and paired by reading scores, then, randomly assigned to treatment. Treatments were administered on two consecutive days followed by a posttest and a delayed posttest. Analysis of variance, F test at the .05 level, was used to test the effects of three independent variables--treatment, sex, and reading ability--on the criterion variables.

Results

On the immediate posttest, no significant differences occurred in the mean scores between the two treatment groups and between the sexes. On the delayed posttest, the game group scored significantly higher ($p < .05$) than the programmed instruction group. On both tests, reading ability was a significant ($p < .05$) source of variation in the data.

Conclusions

The data produced evidence that the game group, while not learning more geographic information, than the programmed group, retained more over a period of time.

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National Center for Educational Research and Development

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INTRODUCTION

This study provided a summative evaluation of the effects of the simulation game "Sailing Around the World" as an instructional technique with fifth-grade students. The primary purpose of "Sailing Around the World" was to teach the location and direction of the world's ocean current patterns and wind systems. Also, the simulation game was designed to develop skill in plotting location and identifying cardinal and intermediate directions.

Virtually every authority on simulation game research speaks of the need for studies specifically designed to test the effectiveness of games compared to other instructional methods (Beck & Monroe, 1968; Boocock & Schild, 1968; Fletcher, 1970; Gordon, 1970; Livingston & Stoll, 1971). It is necessary that educators have sound data concerning the relative effectiveness of teaching devices, such as simulation games, so that program implementation decisions can be made with more assuredness.

To provide validated data on the effectiveness of "Sailing Around the World," the study assessed the effects of the game in terms of cognitive learning, retention of learning, and differential cognitive impact on certain types of students in comparison with another instructional technique--programmed instruction.

The effect of the game in terms of student acceptability was also of interest. A consistent finding in simulation game research has been the high, positive affect associated with gaming. Since "Sailing Around the World" is a new game, it was important to see if the game elicited a more favorable reaction than the programmed text.

Review of Literature

Three types of simulation game evaluation research can be identified. They are: (1) descriptive studies of the effects of a particular game on participants; (2) explanatory studies which attempt to relate outcomes for particular players to other variables; and (3) comparative studies of learning in games as opposed to learning through other educational experiences. (Fletcher, 1969)

Descriptive Studies. Every game that reaches mimeographed form is usually complemented by a descriptive study. Typically, the game is administered to a suitable, available group of subjects. Data describing what is learned from the experience is usually limited to subjective observations by the game designer and the involved teachers. Some studies asked the students to tell what they learned or what they thought they learned and others used more objective means of measuring game outcomes. For example, Kasperson (1968) provides a resume of the evaluations of the games developed for use in the High School Geography Project. These evaluations employed teacher and student questionnaires as the post-treatment observations. Bitten (1970) designed an objective test to use as the pre- and posttest.

These types of game evaluation are inadequate. Only one group of subjects are studied; therefore, this type of research falls within the realm of case studies. As such, the threats to internal and external validity are not overcome, possible sources of bias are numerous, and the number of alternative hypotheses to explain the noted effects is virtually limitless. Stanley and Campbell (1963) suggest that the value of such a study is to generate hypotheses for further, more rigorous testing. This descriptive data is interesting, but it is not the reliable information that is needed to make a judgment on the educational effectiveness of a simulation game.

Explanatory Studies. Some games which survive the initial field trial are submitted for further testing. The next stage of testing usually consists of trying to establish cause-and-effect relationships for the varying impact of the game on particular subjects. Inbar (1968) gathered voluminous data on dependent and independent variables which possibly account for differential game impact. However, statistical analysis of the data showed that only 25 percent of the variance was accounted for by the independent variables. Inbar concluded that he had missed the important variables. Other studies, (Zaltman, 1968; Farran, 1968; Karweit & Livingston, 1969; Inbar, 1966; Livingston, 1970a and Edwards, 1971) investigating a multitude of variables, have not been any more successful in answering the question: What variables mediate game influence?

A major contribution of the explanatory studies concerns two independent variables which have consistently been the object of research: sex and ability of the subjects. Simulation game literature is replete with claims that through gaming differences in student ability can be overcome (Gordon, 1970; Boocock & Schild, 1968; Abt, 1970, Nesbitt, 1968; and Livingston & Stoll, 1971). Gordon (1970) proclaims: "There is no guarantee that students of higher ability will necessarily win the game. Games provide equal opportunity for all to learn." [p. 45] If games can provide equal opportunity to learn, the technique will certainly be an invaluable teaching aid. A number of studies (K. J. Cohen, 1964; Inbar, 1965; and Boocock, 1966) support Gordon's claim as they report only a weak relationship between learning in a game situation and academic performance in the conventional school setting.

Boocock and Schild (1968) have hinted that the low correlations between ability level and learning from a game may be explained by the fact that no study included the full range of students from the very gifted to the very unsuccessful. Therefore, it seems imperative that the evaluation of a simulation game investigate the game's effectiveness with students of different ranges of ability.

Another independent variable which possibly mediates game effectiveness is the sex of the subjects. Fletcher (1969) noted that previous research indicated a relationship between sex, role played in the game, and learning from the game. The correlation was substantiated in his study of games that simulated an Eskimo caribou hunt. These games did not appear to teach girls as effectively as boys. Game evaluation should be concerned with accessing the possibility of a sex bias.

Explanatory studies are a necessary step in the evaluation of a simulation game because they provide needed information concerning the conditions under which the game is most effective. However, to terminate the evaluation of a game at this stage leaves unanswered a question that is important if games are to justify the extensive claims of simulation game advocates. The question is: Do games teach particular things more effectively than other methods?

Comparative Studies. The third classification of simulation game research, the comparative approach, usually contains the elements of descriptive and explanatory studies but its major focus is to investigate the value of gaming relative to other educational experiences. Table 1 summarizes a number of the comparative studies conducted thus far.

The mixed nature of the results reported makes it difficult to generalize about the comparative effectiveness of simulation gaming as an instructional technique. In addition, most of the comparative studies have research deficiencies which qualify the results of the game evaluations.

A perplexing problem is the establishment of a valid control group. Some researchers have employed regular classroom instruction in the comparative analysis design. Unfortunately, the researchers seldom specify what went on in these conventional classrooms. As a consequence, we do not know the nature of the technique that was involved in the comparison with the simulation games.

Two additional problems have been ignored by many simulation game researchers. First, the possible Hawthorne effect of the simulation game has been neglected. Boocock and Schild (1968) advise that including a novel teaching method in the control treatment would help control for the Hawthorne effect. Second, very little effort has been made to control the behavior of treatment administrators thereby inviting a possible bias associated with differential implementation of the experiment.

Another weakness in game evaluation has been that most studies employed a single play of the game. Bias is introduced because the first time students play an unfamiliar game they spend a lot of time just learning how to play the game. Comparative treatments which are more similar to the students normal class routine would not be effected as much by the need to orient to a new teaching situation. This problem is a particularly serious one because learning from games involves a cyclical process of decision-making, feedback, and new decisions. One play of the game limits the number of cycles possible thereby limiting the teaching power of the game (Fletcher, 1970).

TABLE 1

Summary of Studies Comparing Simulation
With Other Educational Experiences

Researcher	Simulation Game	Comparative Educational Experience	Results Favored
K. C. Cohen (1969)	Consumer, Democracy	Regular class experience	Simulation game
Livingston (1970b)	Trade and Develop	An unrealted exercise	No significant difference
Baker (1968)	Pre-Civil War Simulation	Lecture plus read-and-recite from textbook	Simulation in both post- and delayed posttest
Johnson and Euler (1972)	Life Career	Teacher-taught unit featuring lectures and filmstrips	Immediate Posttest--teacher-taught unit Delayed Posttest--simulation game
Anderson (1970)	Consumer Credit Game	Conventional Instruction	No significant difference
Fennessey, et al. (1972)	Make Your Own World	Simulation activity, Conventional instruction	No significant difference
Boocock, Schild and Stoll (1967)	Life Career, Democracy	Conventional instruction	Conventional instruction
Garvey and Seiler (1966)	Inter-nation	Conventional instruction	Conventional instruction

Instrumentation is another problem area in simulation game research. Most researchers have tested for factual learning, but do not give information concerning the genesis of the test or the types of knowledge the instrument is trying to measure. Fletcher (1969) suggested a systematic means to measure the effects of a simulation game. Using the operational definitions of dependent variables, questions can be devised to assess the effectiveness of any game.

Recommendations for Further Research

A review of literature identifies the following recommendations for simulation game evaluation:

1. There should be more rigorous testing of simulation games at the elementary school level. Only two studies (Fletcher, 1969 and Fennessey et al., 1972) have presented validated experimental data using samples below the sixth-grade. Most of the literature on simulation gaming in the elementary school is limited to the descriptive case study approach.

2. The sample employed should include a wide range of student abilities to measure how students of varying ability levels react to the game.

3. Emphasis should be placed on the comparative approach. Descriptive and explanatory studies lack the scope and applicability of a comparison study. Comparative studies can be developed which contain the essential features of description and explanation which estimate the merit of the game relative to other possible methods of teaching the same content.

4. Description of the activities included in the control treatment must be provided so that the type of teaching strategy or method involved in the comparative evaluation is evident. Since both groups are usually evaluated by the same instrument, the treatments should have comparable objectives.

5. The administration procedures of the comparative treatments should be delineated to avoid the possible bias associated with differential implementation of the experiment. Replication of existing studies is difficult because researchers have not explained how potential intervening variables were handled.

6. The research design should control for the Hawthorne effect of the game.

7. Systematic attention should be given to the dependent variables in the research studies. Fletcher's (1969) procedure of writing test items to measure operationally defined categories of educational objectives is an advance toward making the evaluation results less game specific and more generalizable from game to game. Also, the use of Fletcher's categories insures that a wider range of objectives will be assessed.

Problem

The questions that served as the focus of the study were: Is the simulation game a more effective medium for cognitive instruction than some other teaching method? With what types of players is the game most effective? Do students react more favorably to a simulation game than to some other approach to learning?

Hypotheses

The effects of three independent variables--treatment, reading ability, and sex--were investigated. The experimental and control treatments were the simulation game "Sailing Around the World," also referred to as "Sailing," and an investigator-developed programmed unit, which used Buchanan's Programmed Geography (1963) as a guide, respectively. Using the Intermediate I Reading Tests of the Stanford Achievement Test subjects were divided into high, average, and low reading ability groups. Students whose reading grade level was between 4.0 and 6.0 were considered average reading ability. Students above 6.0 and students below 4.0 were considered high reading ability and low reading ability respectively.

The nature of the three independent variables dictated that, in studying the subject's cognition of geographic information, a 2 x 3 x 2 (Treatment x Reading Ability x Sex) factorial design would be appropriate. To analyze the effects of each of the independent variables, the variation observed in the experimental data was divided into eight sources as shown in Table 2. The table also shows the null hypotheses related to each of the sources of variance. Hypotheses 1-3 are concerned with determining whether the independent variables--the main effects of treatment, reading ability and sex--were significant sources of variation in the criterion variables. The interaction hypotheses (Hypotheses 4-7) were designed to see if particular combinations of treatment, reading ability, and sex resulted in relatively greater learning than other combinations.

The seven hypotheses listed in Table 2 were tested using data collected immediately after treatment, and retested using data collected two weeks after treatment. The cognitive criterion variables measured by the instrument were: (1) knowledge of facts about ocean currents and winds, (2) knowledge of principles concerning ocean current and wind patterns, (3) skills in plotting location and identifying directions and combining these three--total cognition of geographic information.

TABLE 2

Source of Variance, Variance Estimates and Null Hypotheses in a

2 x 3 x 2 Factorial Design

Source of Variation	Variance Estimate	Null Hypothesis
Treatment (T)	s_t^2	(1) No significant difference between two treatment groups.
Reading Ability (A)	s_a^2	(2) No significant difference between the three reading ability groups.
Sex (S)	s_s^2	(3) No significant difference between the two sexes.
T x A (interaction)	s_{ta}^2	(4) The treatments are not differentially effective at the three levels of student reading ability.
T x S (interaction)	s_{ts}^2	(5) The treatments are not differentially effective between sexes.
A x S (interaction)	s_{as}^2	(6) There is no significant interaction between reading ability and sex.
T x A x S (interaction)	s_{tas}^2	(7) There is no significant tripe interaction between treatment, reading ability, and sex.
Within Cells	s_w^2	---

Programmed instruction was chosen as the comparative treatment because it had been established as a viable method for imparting selected geographic learnings to fifth-grade students (Buchanan, 1963). Although Buchanan's program was an entire course in geography, it included the learnings that were the instructional objectives of the simulation game, "Sailing Around the World." Using Buchanan's course as a structural and procedural guide, a programmed unit was constructed tested, and revised before it was used as the comparative treatment in the study.[2]

On two consecutive days, during the regularly scheduled social studies time periods, the experimental group played "Sailing." Instruction sheets describing how to play the game were given to each game player. The administrator of the game read these instructions[3] aloud, stopping to demonstrate a few hypothetical moves, before the students were allowed to start a game of their own. During the play of the game, the administrator was available for individual help if a player had methodological questions or problems. This help was limited to clarification of rules and observation of one move in the game to make sure that pupils understand what they were to do. At the end of class, materials were collected with no postgame discussions.

At the same time, the control group was given the instructions explaining how to implement the programmed lessons. The administrator read the instructions verbatim and demonstrated a few sample frames. The program administrator also gave individual aid as requested by the subjects to insure that the pupils knew what to do.

Administrative procedures were standardized[4] and administrators were randomly assigned and then systematically rotated. Also, the two rooms available for the study, one was the regular classroom, were systematically rotated.

Since the teachers had not previously used simulation games or programmed instruction with their students, no practice-effect bias existed. Since both treatments were novel compared to the teacher's normal method of instruction, the Hawthorne effect was present for both treatments.

On the third day of the experiment the instrument measuring the criterion variables was read to all subjects during their regular social studies classes. The subjects also read the questions and responded to the oral and verbal cues. Two weeks later, using the same instrument, the data collection process was repeated. Instrument administrators were randomly assigned to the posttest and rotated for the delayed posttest.

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[2] A copy of the program is included in Appendix C.

[3] A copy of the instructions as well as a description of the game is included in Appendix C.

[4] A copy of the directions for administering the game, the program, and the instrument are included in Appendix B.

The tests of the hypotheses stated above were analyzed to answer the following questions which were posed in the problem statement: (1) Does the game teach better than some other method? and (2) With what type of player is the game most effective?

The question of students' attitudes toward the game was treated by the hypothesis: Students who play the simulation game will have significantly higher scores on the attitudes toward treatment subtest than students who are taught by the programmed unit. This hypothesis was tested using data collected at the posttest and retested using delayed posttest data.

The final hypothesis investigated the extent to which players were able to recognize analogies between the symbolic environment of the game and the situation it was designed to simulate. Since only students who played the game could respond to the analogies questions, it was not possible to have a comparison group score so an adjustment for random expectation was made. This hypothesis was stated: On the subtest labeled analogies between the game and the actual situation, students who played the game will have significantly more correct responses than the number expected by chance. The hypothesis was tested using posttest data and retested using delayed posttest data.

PROCEDURES

The subjects for the experiment were drawn from the population of fifth-grade students at the Oglethorpe County Elementary School (Lexington, Georgia) and the Oglethorpe Avenue Elementary School in adjoining Clarke County (Athens, Georgia). Fifth-grade was considered the educationally relevant and significant population because the topics included in the treatments are normally components of social studies curricula at this grade level. The Oglethorpe schools were utilized because a wider range of student reading ability was assured, thus adding scope to the game evaluation.

A stratified random assignment procedure[1] was used to create comparable treatment groups. One week prior to treatment, the Intermediate I Reading Tests, Stanford Achievement Test was administered in each of the eight fifth-grade classes. The students were ranked by sex on the basis of the reading scores and paired according to rank (the top two boys, the top two girls, the next two boys, etc.). One member of each pair was randomly assigned to the experimental group, the other was assigned to the control group. Since research literature indicated that sex and ability often account for differential game impact, stratification according to these variables followed by random assignment created treatment groups as comparable as possible through a process that was free from bias.

Instrument

The criterion variables, the effects of treatment, were measured by means of an investigator-constructed instrument designed to assess the outcomes of the simulation game in terms of the game's educational objectives. The comparative treatment, programmed instruction, had the same objectives as the game. The instrument designed for this study was developed using the dependent variable categories which were operationally defined by Fletcher (1969). The entire instrument is included in Appendix A.

Five of Fletcher's categories were used to delineate the content of the subtests included in the instrument. The first subtest, knowledge of facts of the real situation, asked for the names, the location, and the direction of various ocean currents and prevailing winds. The category--knowledge of strategies or principles--was a list of generalizations concerning winds and ocean currents. The student indicated his degree of agreement with each statement. The skills subtest required the student to locate a point on a grid system and to identify specified cardinal or intermediate directions. Subtest 4 measured the treatments' impact in affective terms. The questions consisted of statements of feeling, or attitude, toward treatment followed by a Likert five-point scale ranging from strongly disagree to strongly agree. The fifth category, knowledge of analogies between

[1] This procedure was based on a design employed by Livingston, 1970b).

the game and the real situation, measured the simulation game players recognition of analogs between the symbolic, abstracted environment in the game and the actual situation by stating a rule in the game and having the respondent choose the best reason for having such a rule.

A table of specifications was developed to enable the researcher to build content validity into the instruction. Table 3 matches the test items with the objectives of the treatments involved in the study. The test items were submitted to two social science educators and a geographer along with a copy of the program, a demonstration of the game, and the treatment objectives. These individuals judged that the questions contained face validity.

Using the item statistic data gathered during the administration of the posttest, reliability coefficients were calculated for the instrument and its subtests, as shown in Table 4.

TABLE 3

Table of Specifications for Instrument Designed to Measure Effects of Treatment, Matching of Test Item with Objectives

Objectives \ Subtest Categories	Test Item				
	Knowledge of Facts 40%	Knowledge of Strategies 20%	Skills 20%	Attitudes Toward Treatment 10%	Analogies 10%
1. Name and locate ocean currents	1-10				
2. Identify ocean current directions	17-29				
3. Name and locate winds	11-16	1,11,13			
4. Identify prevailing wind patterns	11-16	2,3,14			
5. Recognize general patterns of ocean currents		4-10,12,15			
6. Plot location			1-6		
7. Identify cardinal and intermediate directions			7-12		
8. Recognize analogies between game and simulated situation					1-5
9. Attitudes toward treatment vis-a-vis other social studies lessons				2-7	
10. Attitudes toward treatment vis-a-vis other school activities				3-4	
11. Attitudes toward continued use of the treatment				5-7	
12. Motivation to learn more about the subject				1,6	

Note.--Each of the five subtests was numbered consecutively starting with number 1. Some items tested more than one objective.

TABLE 4

Reliability Coefficients of the Investigator-Constructed Instrument Designed to Measure Treatment Effects

Test or Subtest	$KR_{20}r$
Subtest #1 (Facts)	.48
Subtest #2 (Strategies)	.32
Subtest #3 (Skills)	.65
Total Test #1, #2, and #3	.67
Attitude Subtest	.39
Analogies Subtest	.50

Reliability coefficients of this magnitude would not permit comparisons of individual's scores, but they do permit accurate comparisons of groups. (See Thorndike and Hagen (1961, p. 90) for a discussion of reliability in comparing group scores.)

Design of Study

The basic research design selected for the study was Stanley and Campbell's (1963) Posttest-Only Control Group Design. The design may be diagrammed:

R	X_1	O_{pt}	O_{dpt}
R	X_2	O_{pt}	O_{dpt}

The R indicates random assignment of subjects to groups. X_1 represents the experimental treatment, the simulation game, and X_2 stands for the programmed instruction treatment. The O's represent the investigator-constructed instrument which served as the immediate posttest and the delayed posttest given two weeks after treatment.

The two basic assumptions which led to the rejection of pretest designs in favor of the posttest-only design were: (1) randomization created groups which were comparable in terms of the criterion variables and (2) most students who had not received instruction pertinent to the information contained in the treatments would not score higher than chance on a pretest.

RESULTS

The results of the study are presented in two sections. The first section addresses itself to the posttest; the second section treats the delayed posttest. The instrument, employed for both posttest observations, consisted of five subtests: (1) knowledge of facts, (2) knowledge of strategies or principles, (3) skills, (4) attitudes toward treatment, and (5) analogies between the game and reality. Subtests 1, 2, and 3 comprised the test of total cognition of geographic information.

Immediate Posttest

Learning of Geographic Information. To study the effects of three independent variables (treatment, sex, and reading ability) on the criterion variables which measured cognition of geographic information, the subjects' responses on the investigator-constructed instrument were analyzed using the Modified University of Georgia Analysis of Variance, Method of Least Squares (MUGALS) program.

Table 5 presents the analysis of data which measured the subjects' total cognition of geographic information contained in the treatments. The seven sources of variation correspond to the null hypotheses stated in Table 2. Tables 6, 7 and 8 present the data analysis for the three subtests that comprised the test of total cognition of geographic information--knowledge of facts, knowledge of strategies, and skills. In all four sets of data related to total cognition of geographic information, the data support Hypotheses 1, 3, 4, 5, and 7. There was no significant difference in the mean scores between the two treatment groups and between the sexes. No significant interactions were found between treatment and reading ability, treatment and sex, or treatment by reading ability by sex. The only significant interaction was reading ability by sex [5] on the test of total cognition of geographic information. In all four sets of data, Hypothesis 2 which referred to the main effect of reading ability was rejected. Reading ability was a significant source of variation in the data measuring cognition of geographic information.

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[5]The version of the Duncan Multiple Range Test incorporated in the MUGALS program was not valid for interactions. Therefore, no further statistical analysis was made concerning the source of the reading ability by sex interaction. However, for further discussion of this interaction and similar reading ability by sex interactions in other sets of data, see page 30.

TABLE 5

Analysis of Variance for Total Cognition of Geographic Information, Posttest

	Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
1	Treatment (T)	43.63	1	43.63	1.70
2	Reading Ability (A)	1480.15	2	740.08	28.87*
3	Sex (S)	38.18	1	38.18	1.49
4	T x A	28.92	2	14.46	0.56
5	T x S	5.35	1	5.35	0.21
6	A x S	228.06	2	114.03	4.45*
7	T x A x S	23.25	2	11.63	0.45
	Model	1737.43	11	157.96	6.16
	Error	4435.30	173	25.64	
	Total	6172.74	184		

TABLE 6

Analysis of Variance for Knowledge of Facts, Posttest

	Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
1a	Treatment (T)	31.54	1	31.54	3.05
2a	Reading Ability (A)	140.89	2	70.44	6.81*
3a	Sex (S)	9.72	1	9.72	0.94
4a	T x A	32.41	2	16.21	1.57
5a	T x S	5.76	1	5.76	0.56
6a	A x S	31.97	2	15.98	1.55
7a	T x A x S	9.71	2	4.86	0.47
	Model	255.48	11	23.23	2.25
	Error	1789.78	173	10.35	
	Total	2045.26	184		

*$p < .05$.

TABLE 7

Analysis of Variance for Skills, Posttest

Source of Variation	Sum of Squares	Degrees of Feeedom	Mean Square	F Ratio
1c Treatment (T)	4.40	1	4.40	0.86
2c Reading Ability (A)	275.15	2	137.58	27.36*
3c Sex (S)	1.10	1	1.10	0.22
4c T x A	9.30	2	4.65	0.93
5c T x S	1.50	1	1.50	0.30
6c A x S	30.05	2	15.02	2.99
7c T x A x S	12.45	2	6.23	1.24
Model	321.53	11	29.23	5.81
Error	870.07	173	5.03	
Total	1191.60	184		

TABLE 8

Analysis of Variance for Knowledge of Strategies, Posttest

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
1b Treatment (T)	8.87	1	8.87	2.11
2b Reading Ability (A)	113.46	2	56.73	13.48*
3b Sex (S)	3.62	1	3.62	0.86
4b T x A	3.70	2	1.85	0.44
5b T x S	1.06	1	1.06	0.25
6b A x S	14.61	2	7.31	1.74
7b T x A x S	13.52	2	6.76	1.61
Model	144.30	11	13.12	3.12
Error	728.19	173	4.21	
Total	872.49	184		

*$p<.05$.

Attitudes Toward Treatment - Immediate Posttest. Table 9 presents the data analysis for the attitudes toward treatment subtest. The significant t test supports the hypothesis that students who played the game "Sailing Around the World," would have significantly higher attitudes toward treatment scores than students who were taught by the programmed text.

TABLE 9

Treatment Group Mean Scores and Test of Significance, Attitudes Toward Treatment Subtest, Immediate Posttest

Treatment Group	Mean	N	Population Variance	Test of Significance
Simulation Game	27.14	93	10.67	$t = 9.90^{*}$
Programmed Instruction	22.28	92		

*Statistically significant, $p < .001$.

Knowledge of Analogies Between the Game and the Real Situation - Immediate Posttest. The final hypothesis, for which data were collected during the posttest, concerns analogies between the game and the real situation that the game was designed to simulate. Analogies questions were applicable to game-players only, thus no comparative data are available. A t test was performed to test the significance of the difference between the mean score of the students who played the game and the value expected by random guessing. The .01 significance level was stipulated because the probability of producing spurious results is increased by the use of chance score as the comparative mean. Table 10 summarizes the data collected pertaining to the analogies subtest. The data supported the hypothesis that students who played the game would score significantly greater than chance on the subtest concerning analogies between the game and the real situation.

TABLE 10

Mean Scores of Students Who Played the Game by Reading Ability Group and Sex, Analogies Subtest, Posttest

Reading Ability Group	Analogies Subtest Mean Scores - Posttest		
	Boys	Girls	Total
High	2.60	2.00	2.27
Average	1.77	1.69	1.73
Low	1.67	1.06	1.24
Total	1.90	1.52	1.72
			$t = 3.32^*$

$^*t_{.01} = 2.66$.

Delayed Posttest

Retention of Geographic Information. Tables 11, 12, 13, and 14 present the data analyses for the seven hypotheses (See Table 2) related to the sources of variation in the delayed posttest data. Table 11 refers to the subjects' scores on the criterion variable termed total cognition of geographic information. Tables 12, 13, and 14 refer to the data collected on the three subtests--knowledge of facts, knowledge of strategies, and skills--which comprised total cognition of geographic information.

The three significant F ratios reported in Table 11 involved the main effect of treatment, the main effect of reading ability, and the interaction of reading ability and sex. The hypothesis of no significant difference in mean scores between the sexes was supported. The reading ability by sex interaction was the only interaction that was statistically significant.

The simulation game group scored significantly higher than the programmed instruction group on the delayed posttest measuring retention of geographic information. The mean retention score for the simulation game group was 21.19 compared to 18.95 for the programmed instruction group. The scores of the three reading ability groups were significantly different from each other at the 5 percent level. The means for the high, average, and low reading ability groups were 25.55, 20.10 and 17.17 respectively.

TABLE 11

Analysis of Variance for Total Cognition of Geographic Information, Delayed Posttest

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
Treatment (T)	184.80	1	184.80	6.45*
Reading Ability (A)	2066.05	2	1033.03	36.04*
Sex (S)	57.29	1	57.29	2.00
T x A	13.63	2	6.81	0.24
T x S	39.95	1	39.95	1.39
A x S	388.83	2	194.42	6.78*
T x A x S	16.93	2	8.47	0.30
Model	2757.06	11	250.61	8.74
Error	5016.76	175		
Total	7773.81	186		

*$p<.05$.

TABLE 12

Analysis of Variance for Knowledge of Facts, Delayed Posttest

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
Treatment (T)	54.84	1	54.84	5.49*
Reading Ability (A)	135.09	2	67.55	6.76*
Sex (S)	36.68	1	36.68	3.67
T x A	27.60	2	13.80	1.38
T x S	7.20	1	7.20	0.72
A x S	62.46	2	31.23	3.13*
T x A x S	0.56	2	0.28	0.03
Model	328.05	11	29.82	2.99
Error	1748.05	175	9.99	
Total	2076.10	186		

*$p<.05$.

In terms of knowledge of facts, as measured by the delayed posttest instrument, the main effect of treatment and the main effect of reading ability were significant. The main effect of sex was not significant. All of the interactions were not significant except the reading ability by sex interaction.

Students who played the simulation game scored significantly higher on the knowledge of facts subtest than the students who were taught by programmed instruction. The mean retention score on the knowledge of facts subtest for the game group was 9.14 compared to 8.02 for the program group.

Students who were reading at the sixth-grade level and above scored significantly higher than students who were reading below the sixth-grade level. The average reading ability and the low reading ability groups did not differ significantly in mean scores. The means for the high, average, and low reading ability groups were 9.86, 8.11, and 7.77 respectively.

TABLE 13

Analysis of Variance for Knowledge of Strategies, Delayed Posttest

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
Treatment (T)	32.22	1	32.22	6.47*
Reading Ability (A)	145.52	2	72.76	14.60*
Sex (S)	1.73	1	1.73	0.35
T x A	24.02	2	12.01	2.41
T x S	0.00	1	0.00	0.00
A x S	20.65	2	10.32	2.07
T x A x S	7.88	2	3.94	0.79
Model	218.65	11	19.88	3.99
Error	872.10	175	4.98	
Total	1090.75	186		

*$p < .05$.

The main effect of treatment and the main effect of reading ability produced significant variation in the delayed posttest data for the knowledge of strategies subtest. None of the other sources of variance were significant.

The mean retention score on the knowledge of strategies subtest for the simulation game group was 6.17 compared to 5.31 for the programmed instruction group. Students who were reading above grade level scored significantly higher than the students who were reading at the fifth-grade level or below.

TABLE 14

Analysis of Variance for Skills Subtest, Delayed Posttest

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F Ratio
Treatment (T)	0.26	1	0.26	0.04
Reading Ability (A)	497.46	2	248.73	36.63*
Sex (S)	0.04	1	0.04	0.01
T x A	7.38	2	3.69	0.54
T x S	12.94	1	12.94	1.91
A x S	51.66	2	25.83	3.81*
T x A x S	3.00	2	1.50	0.22
Model	597.51	11	54.32	8.00
Error	1188.17	175	6.79	
Total	1785.68	186		

*$p<.05$.

In terms of the delayed posttest measurement of skills developed in the treatments, one main effect, reading ability, and one interaction, ability by sex, were significant. The remaining sources of variance were not significant at the 5 percent level. A comparison of the means of the reading ability groups indicated that students with high reading ability scored significantly higher (8.74) than students with average reading ability (6.49). Students with average reading ability scored significantly higher than students with low reading ability (4.64).

Attitude Toward Treatment as Measured by the Delayed Posttest. The hypothesis that students who played the simulation game would have significantly higher attitude scores than the students who were taught by the programmed text was retested using delayed posttest data. The result of the t test comparing the means of the two treatment groups is summarized in Table 15.

TABLE 15

Treatment Group Mean Scores and Test of Significance, Attitude Toward Treatment Subtest, Delayed Posttest

Treatment Group	Mean	N	Population Variance	Test of Significance
Simulation Game	24.80	90	15.28	$t = 6.16^*$
Programmed Instruction	21.10	96		

*Statistically significant, $p<.001$.

The data supported the hypothesis that students who played the simulation game would have significantly higher attitude scores than students taught by the programmed text.

Knowledge of Analogies Between the Game and the Real Situation as Measured by the Delayed Posttest. Table 16 summarizes the data collected on the analogies subtest, administered to game-players only, two weeks after treatment.

TABLE 16

Mean Scores of Students Who Played the Game by Reading Ability Group Sex, Analogies Subtest, Delayed Posttest

Reading Ability Group	Analogies Subtest Mean Scores - Delayed Posttest		
	Boys	Girls	Total
High	2.80	1.83	2.27
Average	1.67	1.45	1.59
Low	1.45	1.37	1.41
Total	1.79	1.52	1.68
			$t = 3.17^*$

*$t_{.01} = 2.66$.

The data supported the hypothesis that students who played the game would score significantly greater than chance on the subtest concerning analogies between the game and the real situation.

Summary of Major Results

Immediately after treatment there were no significant differences between the means of the two treatment groups in terms of the learning of geographic information. Two weeks after treatment, the students who played "Sailing" scored significantly higher than students who were taught by the programmed text, on the test measuring retention of geographic information. There was a significant difference in favor of the game in terms of the retention of facts and strategies. Reading ability was a significant source of variation in the data on both the posttest and the delayed posttest. On the attitudes toward treatment subtests, game-players had significantly higher scores than students taught by the program as measured immediately after treatment and after a two-week interval. Game-players scored significantly greater than chance on the subtest labeled analogies between the game and the real situation.

DISCUSSION

The major thrust of this study was to assess the effects of "Sailing" in comparison with another teaching method, programmed instruction, which had identical educational objectives. Comparative assessments were made immediately after treatment, the posttest, and two weeks after treatment, the delayed posttest.

Discussion of Posttest Findings

Effects of Treatment--Learning of Geographic Information, Posttest Measurement. An examination of the posttest mean scores for total cognition of geographic information (Table 17) of the various treatment, sex, and ability groups indicated that for 11 of the 12 possible comparisons the simulation game groups scored higher than the programmed instruction groups. Only the girl subjects with high reading ability who were taught by the program outscored their counterparts who played the game.

TABLE 17

Comparison of Means by Treatment Group, Sex, and Reading Ability Group, Total Cognition of Geographic Information, Posttest

Reading Ability Group	Sex	Total Cognition - Posttest Means		Difference in Means in Favor of Game
		Simulation Game	Programmed Instruction	
Low	Boys	18.00	17.70	+0.03
Average	Boys	22.22	19.25	+2.95
High	Boys	28.10	27.30	+0.80
All	Boys	21.77	20.24	+1.53
Low	Girls	19.52	18.00	+1.52
Average	Girls	22.00	20.76	+1.24
High	Girls	22.92	23.71	-0.79
All	Girls	21.11	20.70	+0.41
Low	Both	18.80	17.82	+0.98
Average	Both	22.13	20.14	+1.99
High	Both	25.27	25.21	+0.06
All	Both	21.44	20.48	+0.96

On the three subtests which constituted total cognition of geographic information, the treatments were not significantly different in terms of effectiveness. The posttest means for the treatment groups are presented in Table 18. The simulation game group scored higher on the knowledge of facts and knowledge of strategies categories while the program group scored higher in the skills category. None of the differences are statistically significant.

TABLE 18

Treatment Group Means on the Subtests Measuring Cognition of Geographic Information, Posttest

Subtest	Posttest Treatment Group Mean	
	Simulation Game	Programmed Instruction
Knowledge of facts	8.87	7.98
Knowledge of strategies	5.90	5.55
Skills	6.67	6.95

The data collected immediately after treatment indicated that "Sailing Around the World" was as effective as a programmed text in teaching the names, location, and direction of the world's major wind and ocean currents as well as developing locational and directional skills.

Effects of Sex and Reading Ability - Learning of Geographic Information, Posttest Measurement. From the review of literature the researcher identified two independent variables, sex and ability, that might mediate the impact of "Sailing Around the World." Thus, a 2 x 3 x 2 (treatments by reading ability by sex) factorial design was employed in order to parcel out the variance observed in the criterion variables to its appropriate sources. Analyses of posttest data for the test of total cognition of geographic information, knowledge of facts, knowledge of strategies, and skills all indicated that reading ability was the main source of variation in the experimental data. Ability to read was a key to success in both treatments. The finding of a significant impact of reading is at odds with the contention of Livingston and Stoll (1971) that games "mobilize skills unrelated to the reading skills necessary for success in conventional classroom activities." However, this finding is probably due to the nature of "Sailing Around the World" and it is not generalizable to many other types of simulation games. The feedback system in "Sailing consisted of geographic information printed on cards. Although the cards contained diagrams, figures and maps to help the poor reader interpret the information,reading comprehension was still the main vehicle of information transmission. By comparison, the amount of reading required to play Market, another fifth-grade simulation game, is minute.

The main effect of sex was not significant throughout the various analyses of posttest data. It should be mentioned, however, that boys who played the game outscored girls who played the game while the reverse was observed for the subjects in the programmed instruction group.

In the analyses of data for the knowledge of facts, knowledge of strategies, and skills subtests none of the interactions were significant. This means that particular combinations of the three independent variables (treatment, sex, and reading ability) did not pr duce differential criterion variable results beyond those attributed to the main effects. In the data analysis for total cognition of geographic information, only the interaction between reading ability and sex was significant. Boys who were reading at, or above, the sixth-grade level learned more geographic information than students in the other reading ability by sex groups.

This investigation was primarily concerned with the interactions involving treatment. These interactions provide insights into whether or not the game is particularly effective, or ineffective, with certain types of students in comparison to similar types of students who used programmed instruction. The interactions involving treatment were not significant. Nevertheless, the data in Table 17 indicated that while both treatments were effective with high reading ability students, the game seemed to be more effective for the average and below average readers. Although the effectiveness of both treatments was heavily based on reading ability, learning from the game was not as dependent on reading as learning from the program.

Effects of Treatment--Attitudes Toward Treatment Subtest, Posttest Measurement. The data measuring the affective impact of the treatments favored the game. As Table 19 shows, all groups of subjects, regardless of sex and reading ability rated the game higher than the programmed unit. This finding is consonant with previous research on simulation games. Virtually every study has reported favorable student attitudes toward gaming.

TABLE 19

Comparison of Means by Treatment Group, Sex and Reading Ability Group, Attitudes Toward Treatment, Posttest

Reading Ability Group	Sex	Attitudes Toward Treatment Means		Difference in Means in Favor of Game
		Simulation Game	Programmed Instruction	
Low	Boys	26.00	22.96	+3.04
Average	Boys	28.73	22.17	+6.56
High	Boys	30.20	20.30	+9.90
All	Boys	27.94	22.16	+5.78
Low	Girls	27.00	22.69	+4.31
Average	Girls	24.38	22.00	+2.38
High	Girls	27.25	22.57	+4.68
All	Girls	26.33	22.40	+3.93
Low	Both	26.53	22.85	+3.68
Average	Both	26.90	22.07	+4.83
High	Both	28.59	21.63	+6.96
All	Both	27.14	22.28	+4.86

Added importance can be attached to this finding in the present study because most previous studies have not pushed the attitudinal evaluations to the point where the "Hawthorne effect" can be discounted (Fletcher, 1969). This is particularly noted in the research which compared games to conventional classroom instruction; the strong positive affect reported might have been a function solely of the novelty of the gaming experience. In the present study both treatments were novel approaches to social studies instruction. Thus, a "Hawthorne effect" operated for both groups. A comparison of students' feelings toward the two new treatments is a more rigorous test than a comparison between one new and one old teaching technique. Students who played the game expressed an interest in

learning more about winds and ocean currents, and thought that the gaming experience was more interesting than typical social studies instruction.

Effects of Treatment--Analogies Subtest, Posttest Measurement. The final category of posttest data measured knowledge of analogies between the game and the real situation that the game was designed to simulate. A simulation game is, by definition, an abstraction from reality. Particular aspects of the game represent, in abstract form, components of the simulated environment. The findings of the present study indicate that students were able to recognize the particular abstractions incorporated in "Sailing Around the World." When the data from the analogies subtest is analyzed by ability groups, a trend can be discerned. As ability level increases, the number of correct responses increases. Fletcher (1969) and Edwards (1971) reported similar trends in data collected on analogies-type questions.

Discussion of Delayed Posttest Findings

Effects of Treatment--Retention of Geographic Information, Delayed Posttest Measurement. Two weeks after the posttest, the delayed posttest was administered to all subjects to measure retention of geographic information included in the treatments and to reexamine the attitudinal impact of treatment.

A comparison by treatment group of the delayed posttest-mean scores for total cognition of geographic information showed that the simulation game group scored significantly higher than the programmed instruction group. The present study and two others which employed a delayed posttest design (Baker, 1968; Johnson & Euler, 1972) have reported significantly superior retention rates for the students who played simulation games. To emphasize this point, Table 20 shows a comparison of posttest and delayed posttest scores for the various divisions of the treatment groups.

TABLE 20

Comparison of Learning and Retention, as Measured by Posttest and Delayed Postest Means, Total Cognition of Geographic Information

Divisions of Treatment Groups	Simulation Game			Programmed Instruction		
	Learning: Immediate Posttest	Retention: Delayed Posttest	Change	Learning: Immediate Posttest	Retention: Delayed Posttest	Change
All Subjects	21.44	21.19	-0.25	20.48	18.95	-1.53
Boys	21.77	21.70	-0.07	20.24	18.35	-1.89
Girls	21.11	20.62	-0.49	20.70	19.61	-1.09
High Ability	25.27	25.86	+0.59	25.21	24.68	-0.53
Average Ability	22.13	21.41	-0.72	20.14	18.96	-1.18
Low Ability	18.80	18.32	-0.48	17.82	15.68	-2.14

Since the instrument was cognitively oriented, lower retention scores were to be expected on the delayed posttest due to the normal tendency of students to forget a portion of knowledge learned. The noteworthy aspect of these data, comparing the results of the two posttests, is the loss in learning as measured by the decrease in the mean scores. The mean of the program group dropped 1.53, while the mean of the simulation group decreased only 0.25.

To explain the high retention rate for students taught by simulation it is necessary to look at the nature of the specific game "Sailing Around the World." The major determinant of success in "Sailing" is the ability to acquire and apply a knowledge of ocean currents and winds. The feedback mechanism in the game supplies information which the player uses in subsequent decision-making situations. The cyclical process of making a decision, feeding it into the game model, obtaining feedback, and making a decision again is consistent with the general model of learning in simulation games (Fletcher, 1969). This frequent application of knowledge which is built into "Sailing Around the World" is an aspect of instruction which is often neglected in gaming as well as in social studies instruction. Much social studies teaching is purely information transmission and the opportunities to apply knowledge are limited. "Sailing" teaches wind and ocean current factors and throughout the game the student makes decisions based on the information he discovered in previous moves. The practice effect which is built into the game results in a type of learning that Coleman (1967) contends is fixed in the student's memory.

Both treatments effectively imparted knowledge to students. However, as measured by the delayed posttest, it appears that there was less attrition of simulation gaming learning. According to Coleman (1967) this greater retention occurred because game learning was assimilated to achieve a given goal--success in the game--while the programmed text operated on the assumption that the student was already motivated to learn ocean currents, winds, location and direction.

The significant difference between treatment groups in favor of the game on the delayed posttest was apparent in the retention of facts and strategies subtest data. The two treatments were not significantly different in developing skill in plotting and identifying directions. Although the two treatments were not significantly different in facilitating learning, as measured by the posttest for knowledge of facts, strategies, and skills; the measure of retention of facts and strategies showed a significant difference in favor of "Sailing." A knowledge of facts and strategies was essential for success in the game and the players remembered more of them than students instructed by the program. Identifying directions and plotting location were skills which were used during "Sailing" but they were only secondary in terms of determining game success.

Effects of Sex and Reading Ability--Retention of Geographic Information, Delayed Posttest Measurement. The delayed posttest data for the main effects of sex and reading ability confirmed the posttest data, i.e., the non-significance of sex and the high significance of reading ability. There was a tendency in the game group for boys to outscore girls, and in the program group for girls to outscore boys. Differences by sex by treatment were not statistically significant. Reading ability accounted for much of the observed variation in the delayed posttest data. In the analysis of variance for the delayed posttest data measuring knowledge of facts, knowledge of strategies, skills, and total cognition of geographic information, significant differences between reading ability groups were reported. Also, a significant interaction between reading ability and sex was noted in the delayed posttest data. Regardless of treatment, boys who were reading above the 6.0 grade level remembered more geographic information than students in the other reading ability by sex groups.

As measured by the delayed posttest, there were no significant interactions between treatment and reading ability, treatment and sex, or treatment by reading ability by sex. In terms of the evaluation of "Sailing Around the World," this means that the game contains no significant sex or reading ability biases that are not also present in the programmed text.

The nature of the 2 x 3 x 2 factorial design used in the experiment permits a comparison, between treatments, of twelve sets of means for the subjects in the various reading ability by sex groups. Table 21 is a comparison, by treatment, of the group retention mean scores on the test of total cognition of geographic information, as measured by the delayed posttest. "Sailing" was considerably more effective than the program for all groups except the girls with high reading ability. Most striking is the fact that students in the game group who were reading below the fourth-grade level scored almost as high as the average for all students in the program group.

TABLE 21

Comparison of Means by Treatment Group, Sex, and Reading Ability Group, Total Cognition of Geographic Information, Delayed Posttest

Reading Ability Group	Sex	Retention Means - Delayed Posttest		Difference in Means in Favor of Game
		Simulation Game	Programmed Instruction	
Low	Boys	17.42	14.96	+2.46
Average	Boys	21.83	18.15	+3.68
High	Boys	29.60	26.90	+2.70
All	Boys	21.70	18.35	+3.35
Low	Girls	19.21	16.82	+2.39
Average	Girls	20.73	19.67	+1.06
High	Girls	22.75	22.93	-0.18
All	Girls	20.62	19.61	+1.01
Low	Both	18.32	15.68	+2.64
Average	Both	21.41	18.96	+2.45
High	Both	25.86	24.68	+1.18
All	Both	21.19	18.95	+2.24

Effects of Treatment--Attitude Toward Treatment Subtest--Delayed Posttest Measurement. Two weeks after treatment, the students' attitudinal evaluations of the treatments were reexamined. Although the means decreased for both groups, the attitudes toward treatment remained favorable. Attitudes toward the game were significantly more favorable than attitudes toward the program. The positive reaction to the simulation game was maintained after a two-week interval.

Effects of Treatment--Knowledge of Analogies Between the Game and the Real Situation Subtest, Delayed Posttest Measurement. A high rate of retention of simulation game learning was evidenced by the delayed posttest scores on the analogies subtest. Immediately after treatment the mean score for the game-players was 1.72. After a two-week interval the mean decreased to only 1.68. This result must be interpreted cautiously, however. On the immediate posttest the mean for the low ability girls was 1.06. On a five-item subtest a score this low is less than random expectation. On the delayed posttest the mean for the low ability girls increased to 1.37. Thus a portion of the increase could be attributed to better guessing rather than retention of knowledge.

Summary of Major Findings

The programmed text and the simulation game "Sailing Around the World" were not significantly different in facilitating the learning of geographic information, as measured immediately after treatment. "Sailing" was significantly more effective than the program in terms of the retention of learning, as measured after a two-week interval. This finding supports Coleman's (1967) argument that simulation games are especially useful because they teach information which becomes fixed in the memory. Reading ability was a significant source of variation in the data on both the posttest and the delayed posttest. Neither treatment was differentially effective between the sexes. Attitudes toward the game were significantly more favorable than attitudes toward the programmed text. Game-players were able to recognize analogies between the game and the situation it simulated.

CONCLUSIONS

The purpose of the study was to provide a summative evaluation of the simulation game, "Sailing Around the World." An adequate understanding of a given game would involve knowing at least: How well the game teaches particular things in relation to alternative methods? With what types of players is the game most effective? What kind of affective reaction does the game elicit? To answer these questions data were collected immediately after treatment and two weeks after treatment.

How well does the game teach in relation to programmed instruction? The findings of this experiment indicated that immediately after treatment learning to answer questions related to cognition of geographic information was accomplished at least as effectively by "Sailing" as by a programmed instruction approach. There was no significant difference in the mean scores between students who played the game and students who were taught by the programmed text on the posttest measure of total cognition of geographic information. Two weeks after treatment, however, students who played the game scored significantly higher on the test measuring total cognition of geographic information than students taught by the program. Within the confines of this experiment, it can be concluded that geographic information is initially learned as well through "Sailing" as through a programmed text. The simulation game, however, is more effective than the program in terms of the retention of geographic information, as measured after a two-week interval.

Posttest and delayed posttest data were also collected for three specific treatment effects: knowledge of facts, knowledge of strategies, and skills developed in the treatments. Immediately after instruction, there was no significant difference between the simulation game and the programmed text in teaching facts, strategies, and skills. Two weeks later, the students who played the game remembered significantly more facts and strategies than the students taught by the programmed text, but no significant difference was found relative to skills developed in the treatments. Within the confines of this experiment, it can be concluded that specific facts about ocean currents and winds, general wind and ocean current patterns, and locational and directional skills are learned initially as well through "Sailing" as through the programmed text. The learning of facts and principles related to winds and ocean currents was retained to a greater extent by students who played the game than by students instructed by a programmed text.

With what types of players is the game most effective? The 2 x 3 x 2 (Treatment x Reading Ability x Sex) factorial design was employed in order to study the main effects of the independent variables as well as the interactions between them. This type of design allowed the researcher to investigate the possibility of

a differential game impact between the sexes; among the reading ability groups; or between the sexes and among the reading ability groups.

The interactions of treatment by reading ability, treatment by sex, and treatment by reading ability by sex were not significant on any of the sets of posttest data, immediate or delayed. Within the confines of this experiment, it can be concluded that the simulation game contained no significant biases toward subjects, regardless of sex or reading ability, relative to the effect of the program on individuals in similar sex and reading ability groups. The game contains no biases that are not also contained in the programmed instruction. For example, the game, like the program was most effective with students, especially boys, who were reading at the sixth-grade level or above.

Using the 2 x 3 x 2 factorial design, the experimental subjects were divided into twelve groups, six of which were treated by the simulation game experience. The rankings of the group means were the same for both the posttest and the delayed posttest observations of total cognition of geographic information. Boys in the high reading ability group scored highest, followed by high reading ability girls, boys with average ability, girls with average reading ability, girls with low reading ability, and finally boys with low reading ability. It can be concluded that "Sailing" is most effective when used with students who are reading at, or above, the sixth-grade level. For students who are reading below the sixth-grade level the game is not as effective, but it is still slightly more effective than the programmed text in terms of retention of geographic information.

What kind of affective reaction does the game elicit? Favorable attitudes toward treatment were demonstrated to a greater extent by students who played "Sailing" than students who used the programmed text. There was a significant difference in attitude score means in favor of the simulation game treatment. Within the confines of this experiment, it can be concluded that students who played the game expressed a stronger interest in learning more about winds and currents than students in the programmed text group. Also, students thought that the game was more interesting than typical social studies lessons. The favorable attitude toward the game was maintained after a two-week interval.

RECOMMENDATIONS

Suggestions for Further Research

In addition to the need for replication studies with additional samples and different grades, research is needed to answer the questions: What makes the game work? Why was such a high rate of retention of learning exhibited by game-players? These are questions which become the focus of attention once a game, such as "Sailing," shows indications of being a successful teaching technique. To the extent that this experiment has been valid, there is a need to investigate the causes of the observed effectiveness of "Sailing."

In the discussion section of the report, a possible explanation for the success of "Sailing Around the World" was offered. It was theorized that the game model, because it included a practice effect mechanism which continuously encouraged the acquisition and application of knowledge, facilitated the learning and retention of geographic information. Research is needed to test this theory. Another version of "Sailing" could be developed which differs from the original only in terms of the amount of application of knowledge that the game requires. Using appropriate experimental techniques, the amount of learning from both versions of the game could be measured. The observed difference could be attributed to the change in the practice effect.

A research study of this nature plus similar studies using different games will begin to provide insights as to the quantity and quality of the information system, including the feedback mechanism, that is needed for the successful development of simulation learning games. If future studies show that the amount and frequency of knowledge application is a key to differentiating between effective and ineffective games, designers of games can take advantage of these facts. On the other hand, if the practice effect is not the reason for the high retention of learning, then other variations should be made in the game and research conducted to measure the impact of these changes on the learning and retention of learning that the simulation game fosters.

Another question which arises from the present study is: Will the high retention of geographic information by the simulation game-players be maintained over a longer period of time? Two months later will they still remember more or will the effects of treatment be nullified? The case for simulation games will be strengthened if it can be demonstrated that learning is retained over substantial periods of time.

Implications

The findings and conclusions reported in this study have direct implications concerning the value of the simulation game "Sailing Around the World." The results suggest that "Sailing" is a viable method of teaching geographic information, especially knowledge of facts and principles related to ocean currents and winds, to fifth-grade students. The game apparently has merit for use with a wide range of student abilities. Students who were reading above grade level learned the most from the game implying that "Sailing" could also be useful with sixth- and seventh-grade students. With students of average and below average reading ability the game was more effective than the programmed text which was designed to teach the same information. However, this does not imply that the game provides equal opportunity for all to learn (Gordon, 1970). Reading skill is an important factor in determining what is learned from "Sailing Around the World."

For experimental purposes, in order to isolate the effects of the game, "Sailing" was not tied to a teaching unit. Many posttest scores, on the investigator-constructed instrument designed to measure learning, clustered around the chance level and did not provide the wide spread in the data that is necessary for high test reliability. The low scores might indicate that the content was too difficult for this particular sample of fifth-grade students. But, it might also indicate that the game should be considered for use as a complementary activity which when combined with other teaching techniques would produce optimum results. "Sailing" could be incorporated into the curriculum at various points. Examples of supplementary use are: (1) in a unit on factors which influence climate; and (2) in a unit on the "Age of Exploration and Discovery," the voyages in the fifteenth and sixteenth centuries which initiated the global expansion of Western civilization.

Another implication appears to be that since "Sailing," a solitaire game, was a successful teaching technique, the game has potential as a self-instructional device. The game could function as a learning activity that students could pursue independently at various times in the day.

The immediate posttest data revealed that students seemed to learn as much from "Sailing" as from the programmed instruction, and that students liked the game better. A result such as this for any game is substantial justification for employing the simulation game as an instructional strategy. Also, the significant differences in attitudes toward treatment in favor of the game imply that the favorable reaction toward games was more than just a novelty effect.

The continuous application of knowledge factor which apparently contributed to the high rate of retention of learning by the simulation game-players is a characteristic of "Sailing" which might have a theoretical and practical implication for game designers. For example, games focusing on international politics such as Inter-Nation and Crisis have been successful in teaching processes. In terms of teaching facts, however, simulation games have been less successful. In "Sailing," game-players had to acquire and continuously apply a knowledge of winds and ocean currents. This study suggests that it is possible to design a simulation game which can teach facts. A key factor in the game's design should be the built-in opportunities to apply the knowledge that the game teaches.

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APPENDIX A

THE INSTRUMENT

APPENDIX A: THE INSTRUMENT. KNOWLEDGE OF FACTS SUBTEST

1. Find the Number 1 on the map. Which ocean current would you expect to find in that part of the ocean?

___a) California Current
___ b) Japan Current
___ c) South Pacific Drift
___ d) South Alaska Current

2. Find the Number 2 on the map. Which ocean current would you expect to find in that part of the ocean?

___ a) North Equatorial Current
___ b) Equatorial Counter Current
___ c) Hawaiian Current
___ d) California Current

3. Find the Number 3 on the map. Which ocean current would you expect to find in that part of the ocean?

___ a) North Equatorial Current
___ b) Equatorial Counter Current
___ c) South Equatorial Current
___ d) Tropic of Capricorn Current

4. Find the Number 4 on the map. Which ocean current would you expect to find in that part of the ocean?

___ a) Brazil Current
___ b) West Wind Drift
___ c) South American Current
___ d) Peru Current

5. Find the Number 5 on the map. Which ocean current would you expect to find in that part of the ocean?

___ a) West Wind Drift
___ b) Gulf Stream
___ c) North Atlantic Drift
___ d) Canaries Current

6. Find the Number 6 on the map. Which ocean current would you expect to find in that part of the ocean?

___ a) Canaries Current
___ b) Caribbean Current
___ c) North Atlantic Drift
___ d) African Current

7. Find the Number 7 on the map. Which ocean current would you expect to find in that part of the ocean?

___ a) Brazil Current
___ b) Falkland Current
___ c) South Atlantic Drift
___ d) South American Current

8. Find the Number 8 on the map. Which ocean current would you expect to find in that part of the ocean?

___ a) South Atlantic Drift
___ b) Brazil Current
___ c) West Wind Drift
___ d) Benguela Current

9. Find the Number 9 on the map. Which ocean current would you expect to find in that part of the ocean?

___ a) South African Current
___ b) West Wind Drift
___ c) Benguela Current
___ d) South Atlantic Drift

10. Find the Number 10 on the map. Which ocean current would you expect to find in that part of the ocean?

___ a) South Equatorial Current
___ b) North Equatorial Current
___ c) Equatorial Counter Current
___ d) West Wind Drift

APPENDIX A: KNOWLEDGE OF FACTS (Continued)

11. Find the letter A on the map. The arrows show the direction that the wind is blowing in that part of the world. What name could you give to that wind?

_____a) Equatorial Easterly Wind
_____b) Northwest Trade Wind
_____c) Southeast Trade Wind
_____d) Westerly Wind

12. Find the letter B on the map. The arrows show the directions that the wind is blowing in that part of the world. What name could you give to that wind?

_____a) Equatorial Easterly Wind
_____b) Northeast Trade Wind
_____c) Southwest Trade Wind
_____d) Westerly Wind

13. Find the letter C on the map. The arrows show the directions that the wind is blowing in that part of the world. What name could you give to that wind?

_____a) Southwest Trade Wind
_____b) Northeast Trade Wind
_____c) Easterly Wind
_____d) Westerly Wind

14. Find the letter D on the map. The arrows show the directions that the wind is blowing in that part of the world. What name could you give to that wind?

_____a) Easterly Wind
_____b) Southeast Trade Wind
_____c) Easterly Wind
_____d) Westerly Wind

15. Find the letter E on the map. The arrows show the directions that the wind is blowing in that part of the world. What name could you give to that wind?

_____a) Northwest Trade Wind
_____b) Westerly Wind
_____c) Easterly Wind
_____d) Southeast Trade Wind

16. Find the letter F on the map. The arrows show the directions that the wind is blowing in that part of the world. What name could you give to that wind?

_____a) Northwest Trade Wind
_____b) North Wind
_____c) Westerly Wind
_____d) Easterly Wind

APPENDIX A: KNOWLEDGE OF FACTS (Continued)

Questions 17-26 refer to Map 1 on the separate map sheet that was given to you.

17. Find the letter A on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

___ a) 1 ____ b) 2 ____ c) 3 ___ d) 4

18. Find the letter B on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

___ a) 1 ____b) 2 ____ c) 3 ____d) 4

19. Find the letter C on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

____a) 1 ____b) 2 ____ c) 3 ____d) 4

20. Find the letter D on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

____a) 1 ____b) 2 ____ c) 3 ____d) 4

21. Find the letter E on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

___a) 1 ____b) 2 ____ c) 3 ____d) 4

22. Find the letter F on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

___a) 1 ____b) 2 ____ c) 3 ____d) 4

23. Find the letter G on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

___a) 1 ____b) 2 ____c) 3 ____d) 4

24. Find the letter H on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

___a) 1 ____b) 2 ____c) 3 ____d) 4

25. Find the letter I on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

___a) 1 ____b) 2 ____c) 3 ____d) 4

26. Find the letter J on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

___a) 1 ____b) 2 ____c) 3 ____d) 4

APPENDIX A: KNOWLEDGE OF FACTS (Continued)

MAP 2

Questions 27-30 refer to Map 2 on the separate map sheet that was given to you.

27. Find the letter A on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

___a) 1 ___b) 2 ___c) 3 ___d) 4

28. Find the letter B on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

___a) 1 ___b) 2 ___c) 3 ___d) 4

29. Find the letter C on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

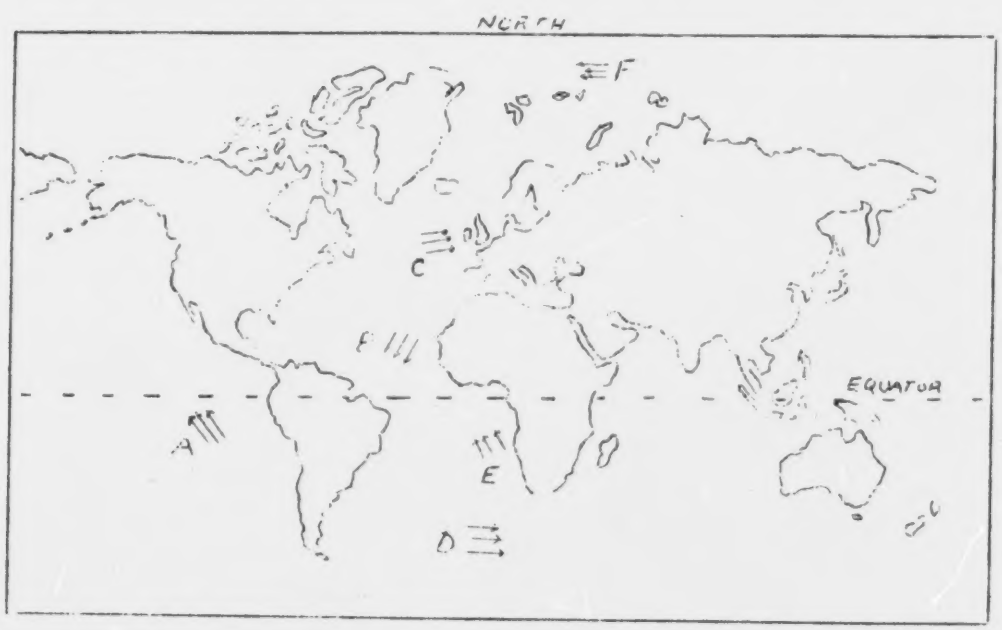
___a) 1 ___b) 2 ___c) 3 ___d) 4

30. Find the letter D on the map. Which arrow shows the direction that the ocean current flows in that part of the ocean?

___a) 1 ___b) 2 ___c) 3 ___d) 4

APPENDIX A: KNOWLEDGE OF FACTS (Continued)

Use the world map above to answer the first ten questions. After each question, put a check mark before the correct answer.



APPENDIX A: KNOWLEDGE OF FACTS (Continued)

MAP 1

APPENDIX A: THE INSTRUMENT. KNOWLEDGE OF STRATEGIES SUBTEST

Read each of the following statements. Then indicate whether you agree or disagree with it. If you cannot decide, check "Not Sure."

	Agree	Not Sure	Disagree
1. A wind blowing toward the east is called an easterly wind.	____	____	____
2. The Trade Winds blow toward the equator.	____	____	____
3. Near the North Pole you could expect the wind to be blowing from east to west.	____	____	____
4. If this figure stands for a continent in the southern part of the world, then the arrow correctly shows the way the ocean current would be flowing.	____	____	____
5. Ocean currents are never found near the coast of a continent.	____	____	____
6. The West Wind Drift flows through the Atlantic and Pacific Oceans but not the Indian Ocean.	____	____	____
7. Ocean currents and winds usually go in the same direction.	____	____	____
8. The ocean currents just north and south of the equator flow in the same direction (east to west).	____	____	____
9. Many ocean currents are named after places in the world.	____	____	____
10. If this figure stands for a continent in the southern part of the world, then the arrow correctly shows the way the ocean current would be flowing.	____	____	____

APPENDIX A: KNOWLEDGE OF STRATEGIES (Continued)

11. At sea, if you are traveling west, a westerly wind will help you along. _____ _____ _____ _____

12. Ocean currents flow in circles. _____ _____ _____ _____

13. A wind that blows from west to east is called a westerly wind. _____ _____ _____ _____

14. Trade Winds blow toward the equator from the same direction. _____ _____ _____ _____

15. Equatorial Currents can be found in the Pacific, Atlantic and Indian Oceans. _____ _____ _____ _____

APPENDIX A: THE INSTRUMENT. SKILLS SUBTEST

Questions 1, 2 and 3 refer to Figure 1

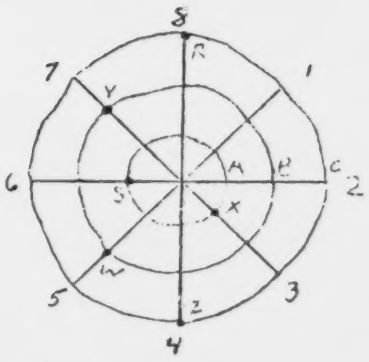


Figure 1

1. B5 is the location of:

___a) point R
___b) point S
___c) point W
___d) point Y

2. C8 is the location of:

___a) point R
___b) point X
___c) point S
___d) point Y

3. A3 is the location of:

___a) point W
___b) point X
___c) point Y
___d) point Z

Questions 4, 5 and 6 refer to Figure 2

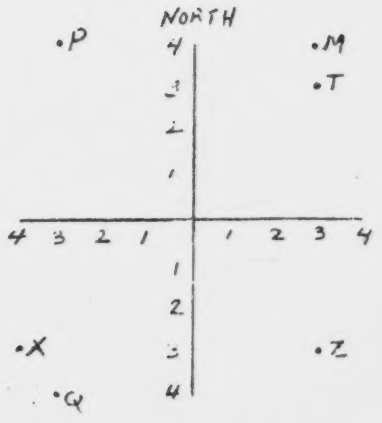


Figure 2

4. East 3, North 3 is the location of:

___a) point Z
___b) point X
___c) point M
___d) point T

5. South 3, West 4 is the location of:

___a) point M
___b) point X
___c) point P
___d) point Q

6. North 4, West 3 is the location of:

___a) point M
___b) point X
___c) point P
___d) point Q

APPENDIX A: SKILLS (Continued)

Questions 7 and 8 refer to Figure 3

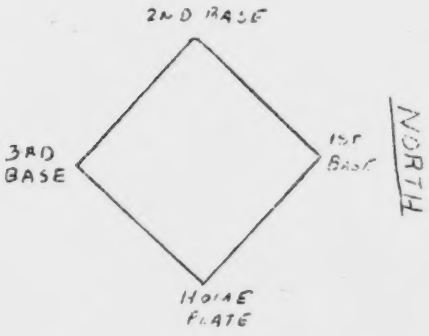


Figure 3

7. On this layout, what direction is third base from first base?

___a) west
___b) north
___c) east
___d) south

8. On this layout what direction is home plate from second base?

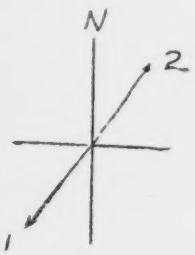
___a) south
___b) east
___c) north
___d) west

9. In the diagram to the right, if N is north, in which direction is arrow number 1 pointing?

___a) south
___b) west
___c) southeast
___d) southwest

10. In which direction is arrow number 2 pointing?

___a) east
___b) north
___c) northeast
___d) southeast



11. In the diagram to the right, if N is north, in which direction is the arrow pointing?

____a) south
____b) west
____c) southeast
____d) southwest

12. In the diagram to the right, if N is north, in which direction is the arrow pointing?

___a) north
___b) northwest
___c) northeast
___d) north northwe -

APPENDIX A: THE INSTRUMENT. ATTITUDES TOWARD TREATMENT SUBTEST

* * * * *

Indicate the amount of agreement or disagreement with each of the following statements.

1. I would like to learn more about ocean currents.

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
___	___	___	___	___

2. I didn't like the lesson as much as other social studies lessons.

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
___	___	___	___	___

3. This way to learn was more fun then reading a book about the subject.

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
___	___	___	___	___

4. I like this way to learn better than other school lessons.

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
___	___	___	___	___

5. I would like more lessons like the one we have just had about ocean currents and winds.

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
___	___	___	___	___

6. I would not like to learn more about winds.

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
___	___	___	___	___

7. More lessons like this will make social studies more interesting.

Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
___	___	___	___	___

APPENDIX A: THE INSTRUMENT. ANALOGIES BETWEEN THE GAME AND AND THE REAL SITUATION SUBTEST

1. In the game if you landed on a space at the side of the game board you were allowed to move to the other side of the board. Which of the following is the best reason for having this rule?

___a) The earth is a sphere so that actually the spaces at each side of the board are next to each other.
___b) A flat map of the world, like the game board, is not accurate. The rule makes the map more accurate.
___c) To make the game easier to play, it would be hard to play the game on a globe.
___d) The rule is not at all like real life. It just makes the game more exciting to have ships coming from two directions at once rather than having all the ships following the same path like in some games.

2. Which of the following was important in sailing around the world in 1500 but was not involved in the game.

___a) luck
___b) poor weather
___c) shipwrecks
___d) not enough knowledge of the oceans

3. In the game each player was allowed to move his ship in any direction he wanted to. Which of the following is the best reason for having that rule?

___a) To make the game more realistic because the ship's captain decided which way he wanted the ship to go.
___b) To make it easier for the players to sail around the world.
___c) To make the game more fun for the players.
___d) It wouldn't really be a game if the decision as to which direction to go was already made for you.

APPENDIX A: ANALOGIES SUBTEST (Continued)

4. In the game, after moving the number of spaces shown on the spinner, each player had to plot his location using the letters on the side of the board and the numbers at the top of the game board. Which of the following is the best reason for having that rule?

___a) In real life the ship's captain had to know where he was so that in case of emergency he could radio for help.
___b) In real life the ship's captain had to have some means of figuring out his location--he usually used latitude and longitude, in this game we use letters and numbers.
___c) Most maps today have letters and numbers, so this just makes the game more modern.
___d) It makes the game more exciting when you pick up a card and discover that something has happened to your ship.

5. In the game the players had to move their ships according to the directions on the ocean carss. For example, if the card said: The Westerly Wind carries your ship two spaces west, you moved your ship two spaces west whether it helped you or not. Why does the game have that rule?

___a) In real life storms and winds blow up suddenly and can carry your ship that far easily.
___b) In real life the ocean and wind currents would be effecting your ship from the minute it leaves shore, so the cards are used to describe the general effects they would have on your ship's progress.
___c) In real life the ships traveled in the daytime so that during the night they just drifted along with the currents and that is what is described on the cards.
___d) In real life the ship's captain had certain rules to obey, if he disobeyed he might have a shipwreck so the game has to have some rules in it also.

APPENDIX B

INSTRUCTIONS FOR ADMINISTERING THE PROGRAM, THE GAME, AND THE INSTRUMENT

APPENDIX B: INSTRUCTIONS FOR ADMINISTERING PROGRAM

1. Check to see that desks are cleared and that each pupil has a pencil.
2. Pass out program booklets, map booklets, and blue cards.
3. Put names on program and map booklets.
4. Make sure that pupils know what to do, how to record answers on the program, etc., To do this, have pupils open to "Introduction." Read Introduction to them as they follow along in their program texts.
5. Have pupils turn the page, Read PART I: DIRECTION AND LOCATION.
6. Do number 1 with them. Use the transparency of program's first page to demonstrate. Cover the answer with the blue card, read the question, answer it (write in the answer), and then slide the card down to check the answer.
7. Do number 2 in the same fashion.

Other Instructions.

a. Before starting them on number 3, tell them they do not have to finish the whole thing in one day.

b. Also tell them that if they don't understand something to raise their hand for help.

c. Point out to the pupils that:

Use map #1	for questions	39-69
2		70-86
3		87-112
4		118-

Write this on the board as a reminder.

INSTRUCTIONS FOR ADMINISTERING PROGRAM (Continued)

Other instructions (continued)

d. While they work on the program walk around the room to make sure the instructions are being followed. Make sure they aren't just copying answers down without covering them up with the blue card. If a student is not implementing the program properly, stop him and show him how to work the program, individually. Give assistance on individual basis without disturbing the class.

e. Allow 5 minutes at the end of class period to pick up materials.

f. On the second day do another sample program frame # 39, just as for number 1 and 2 above. Also project the transparency of Map #1 and demonstrate how number 69 is to be done.

g. Tell them: Before picking up where you left off yesterday, go back and read over what you have done so far to refresh your memories. Re-read the frames, then begin covering frames and working the program as you did yesterday.

h. At the end of the day and during the class time, the administrator can check to see if the children are properly filling in the map questions.

i. Do not accept the programs from the students until they have labelled all the currents properly. Re-check the maps.

j. If people finish before the end of the second class period, have them record the time they finished on the outside of the programmed booklet.

APPENDIX B: INSTRUCTIONS FOR ADMINISTERING THE GAME

1. Make sure all desks are cleared, and that everyone has:
   a. Game board.
   b. Instructions sheet.
   c. Token.
   d. Deck of ocean cards.
   e. Pencil.

   (Have one of each to show as you ask them if they've gotten one.)

2. Put names in the upper right-hand corner of the game board.

3. Make sure pupils understand what to do. Read directions verbatim and supplement with explanations as pupil's questions indicate need.

4. Read "Introduction" as they follow along.

5. Walk through "example of how a game might go." page 2 of "INSTRUCTIONS."
   a. Show how the starting point is identified as B-9.
   b. Demonstrate the move to C-8, F-7, etc.
   c. Show what to do when you get to the edge of the game board.

6. <u>Especially important</u> is to show how to record turns and location on the score sheet at the bottom of the game board; and how to make notes (on the game-board-map) about ocean currents and winds. Emphasize this as you go over rules and demonstrate moves.

7. Before letting them begin their first game, review how to play the game by pointing out the brief set of directions in the upper left-hand corner of the game board. Tell them they can refer to it if they forget the steps in playing the game.

APPENDIX B: INSTRUCTIONS FOR ADMINISTERING THE GAME (Continued)

8. Move about the room to check to see if they are playing the game properly. If they are not, work individually with the student who is having problems to clarify the rules, and then observe one move to see if the student has mastered game procedure.

9. Allow 5 minutes to collect the game materials.

10. On the second day after the equipment has been redistributed, review by pointing out the directions in the upper left-hand corner.

11. Remind them to keep track of their moves on the score sheets because that is the only way to judge whether or not they're improving with each game they play. Also point out that keeping a good record of the currents and winds will make it easier to improve their game scores.

APPENDIX B: INSTRUCTIONS FOR ADMINISTERING THE INSTRUMENT

1. Announce: We are going to try to find out how much you have learned (or remembered) from the game and the program.
2. Be sure that desks are cleared. See that everyone has a pencil, a copy of the test booklet, plus a separate map sheet.
3. Put names in the upper right-hand corner on the first page.
4. Encourage them to do their best, not to look at anyone else's paper, and to answer the questions based on what they learned in the past few days (or two weeks ago).
5. Say: On each question all you have to do is make a check mark to show which answer you think is right.
6. Say: Listen carefully, I will read each question and the possible answers, you pick the one you think is the right answer.
7. No talking or calling out of answers. Be sure students are aware of this before you start reading questions.
8. As you read Question number, tell the students to put their finger on the number on the map, this will give you an opportunity to see if they are following along and know where they are supposed to be. Do this periodically to make sure nobody is lost.
9. On the first question in each section be sure that the students are apprised of any changes in directions.
10. After number 15 of the Knowledge of Strategies subtest, pause to allow the student to stretch.
11. On the last page of the test, questions 1-5 are only for people who played the game. Program people may guess at the answer in this section if they wish; there will be no penalty for a wrong answer.

APPENDIX C

COMPARATIVE TREATMENTS: SAILING AROUND THE WORLD

AND

A PROGRAMMED LESSON ON DIRECTIONS, LOCATION, OCEAN CURRENTS, AND WINDS

Educational Objectives for the Simulation Game
"Sailing Around the World" and for the
Programmed Text: Directions, Plotting, Ocean
Currents, and Winds

As a result of the learning experiences provided by the treatments the student should be able:

1. To name and locate major ocean currents in the Atlantic, Pacific, and Indian Ocean.
2. To identify the direction that the current is flowing in various parts of the oceans of the world.
3. To recognize that winds are named according to the direction from which they blow.
4. To identify the general patterns of prevailing wind in various parts of the world.
5. To recognize the general patterns of ocean currents in various parts of the world.
6. To plot location by means of ordinates and abscissas.
7. To identify cardinal and intermediate directions.
*8. To recognize analogies between the symbolic environment of the game and the actual situation it was designed to simulate.

Affective objectives will be evaluated in terms of approach and avoidance behaviors as exhibited on a Likert five-point rating scale.

9. Attitude toward the treatment in relation to other social studies lessons.
10. Attitude toward the treatment in relation to other school activities.
11. Attitude toward continued use of the treatment.
12. Motivation to learn more about the subject.

*For students who play the game only.

Description of "Sailing Around the World"

Brief Background

During the fifteenth and sixteenth centuries European civilization expanded to the "four corners" of the world. In the chronicles of Western Heritage this era is often referred to as the "Age of Exploration and Discovery." Seafarers from Spain, Portugal, Netherlands, France and England (the countries with relatively easy access to the Atlantic) embarked upon a series of voyages into previously uncharted waters. They explored the unknown seas in ships which were for the most part powered by sail and discovered that a number of geographic phenomena played an important role in the success or failure of their navigations.

Exploration and Discovery are the key words in this simulation game for upper elementary grade students. In "Sailing Around the World" the players will explore relatively unfamiliar waters, the oceans of the earth, and will discover that prevailing winds, ocean currents, and other climatic influences such as icebergs, and calms were extremely important in the journeys of the early sailors. In some cases the geographic phenomena can be a formidable foe, but when located, charted, and carefully considered in planning a voyage students will see that they can become aides to successful navigation on the high seas.

Materials

1. Game board

e game board (19" x 13 1/2") includes a Robinson Projection (Goode's World Atlas, 1970, p. 4-5) of the map of the world. The

map is grided in one-inch squares. Each square can be identified by the column and row that it is in. The rows are labelled A through H and the columns are numbered 1 through 16. At the bottom of the game board is a score sheet where the player can keep a record of as many as 12 games. For each game there is a space where the player writes his location (using letters and numbers) after each turn.

Also included on the game board are: a spinner which tells how many spaces the player is allowed to move, and a brief summary of the sequence of play.

2. Game pieces-ships

Each country is represented by a game piece which is a simulated ship.

3. Prevailing wind and ocean current cards

Each oceanic square has a corresponding card which describes the sailing conditions in that particular part of the high seas. The prevailing winds and ocean currents which have an influence on the ship's course are represented on the cards. Most cards present the information diagrammatically as well as in narrative form. The cards are securely fastened to keep them in alphabetical order.

Rules

The rules are discussed in the second page of "Instruction." The only rule not mentioned has to do with where ships are allowed to move. No ship may move over land; for example, a ship

can never land on E-6. If the space is part land and part water (i.e., C-5), you may move onto the space. You would not be allowed to move from C-5 to D-6, however, because of the land mass in between.

INSTRUCTIONS FOR PLAYING "SAILING AROUND THE WORLD"

Introduction:

"SAILING AROUND THE WORLD" is a game about geography. You will play Magellan, the captain of a ship about to sail from Europe. The year is 1519. In the game you will learn about some of the things that Magellan and other sea captains discovered as they sailed around the world. Your goal is to make it all the way around the world. You must decide which direction you want your ship to go. As you travel you will be given cards that have information on them. These cards tell you about the ocean currents and the winds that effect your ship. When water in the ocean currents and the winds that effect you ship. When water in the ocean moves from place to place this is called a current, these currents push your ship in the direction that the water is moving. Also, moving air or wind blows into the ship's sails and pushes the ship in the direction that the wind is blowing. If you keep a record of the ocean current and wind information, it will help you the next time you try to sail around the world.

Example:

Here is an example of how a game might go.

The player places his ship (the little token that was given to you) at the starting point (B-9) and then spins the spinner to take his first turn. The number 2 comes up on the spinner meaning he can move 2 spaces. He decides that he wants to go one space west and one space south. He lands on C-8. He writes C-8 on the score sheet under the first turn. In the stack of cards he finds the one with C-8 on it. The card gives him this information: The ocean current (Canaries Current) and the trade winds are coming in a northeast to southwest direction. The wind is named the Northeast Trade Wind and it carries your ship one space southwest. The player moves his ship one space southwest as the card told him to. Then he takes his pencil and makes a note of what happened to his ship.

Now the player takes his second turn. This time he gets a 2, and decides to move 2 spaces south, and he lands on F-7. He writes F-7 on the score sheet for his second turn. Then finds the card with F-7 on it. He reads: The Brazil Current flowing from north to south along South America's east coast pushed you one space south. He does what the cards tells him to do, and then makes a note of the current.

The player takes his third turn. And so on.

If the player is to sail all the way around the world, at some point he will have to move off the end of the board on either the left or right side. When the player gets to one side of the board, he can automatically move to the other side. For example, when a player lands on E-1 he can move his ship over to E-16 and continue his trip around the world.

The player finally gets back to the starting point and has taken 13 turns. Now he will play the game again and will try to get around the world in less than 13 turns. In the second game he will have notes from the first game written on the board to help him decide which direction he should travel.

You may want to compare your score with a friend's to see who takes the least amount of turns in sailing around the world.

A Short History of the Game

"Sailing Around the World" originated in 1970 as a project for a graduate course in social science education at the University of Georgia. One of the assignments in the course, as taught by Dr. E. T. Keach, Jr., was to create a simulation game for elementary school students. The decision to develop a game to teach about ocean currents and winds was based on the designer's previously experienced difficulty in teaching the geographic distribution of these phenomena. The game attempts to simulate selected factors which influenced early sailors who circumnavigated the globe. In addition to teaching content about winds and ocean currents, the game was designed to develop skills in plotting and telling directions. During the game's formative evaluation a number of changes were made. The changes were made to facilitate the game's power to accomplish the four teaching objectives mentioned above.

Since a description of the game was provided earlier in this appendix, the main purpose of this section is to recount the modifications that were made in the game and the reasoning behind the changes.

Most of the changes involved the materials of the game. Only a few changes were made in the structure of the game.

Changes in the Game's Structure

The most important modification was the change in the nature of the competitive aspect of the game. Originally, "Sailing" was envisioned as a table-top game with two to five players, representing sea captains from various countries, in competition with each other

to see who would be the first to sail around the world. In the game, it was suggested that players make notes of the factors which influenced their ship's progress. The information was presented on cards, with each card describing conditions in various parts of the ocean. The major drawback of this version of the game was that players, in their haste to see who would be first to sail around the world, were not careful in their consideration of the influencing oceanic factors. Thus, the object of the game (circumnavigating the globe) clouded the educational objectives (knowledge of ocean and wind currents) of the simulation game. The game had to be modified to put a premium on the knowledge of winds and ocean currents. To accomplish this, the role of chance was diminished and the nature of competition was modified. The game was changed so that students would sail around the world once, keeping a record of the number of moves made, to establish a baseline which would be used to judge subsequent game performance. Originally the player's objective was to make it around the world in less moves than his competetors, now he had to sail around the world trying to best his previous record. This change seemed to make students more aware of the need to chart the ocean currents an winds they discovered as they played each game. It also seemed to encourage experimentation with a variety of routes, whereas in the original version the routes of victors were followed very closely in subsequent games. Theoretically this should lead to the discovery of more information. Finally, the sequence of play in the original version contained a bias. For example, player A moved and was

pushed back by an ocean current, player B could then avoid that current. The bias was against the player who moved his ship first. Also, this change was more consonant with reaility. In reality the sea captains of the various countries were trying to see who could find the shortest sea route; they were not simply racing each other as the original game might lead one to believe.

Roles

In order to allow more than two to five students to participate in a game, the role of navigator, in addition to the role of sea captain, was introduced. This meant that two to five teams of two players each could play the game. The sea captain would decide which way the ship would go, and the navigator was in charge of mapping the factors which influenced the voyage. A much larger game board (2' x 4') was designed to accommodate the increase in the number of participants. It became apparent, however, that there was not enough for two people to do, one person could do both jobs so the role of navigator was deleted.

Goals

The goal, to sail around the world, remained the same. When the game was converted from competition among players to a solitaire game, the measure of success for the players was changed. Instead of determining a winner for each game, the goal was to see how you could cut down on the number of moves.

Changes in Materials

Gameboard. The original gameboard consisted of a Robinson projection of the world map. The map (16" x 8") was projected on an 18" x 12" piece of cardboard. A grid system was superimposed to divide the map into 1/2" squares. Each grid was identified by letter (A-P) and number (1-32). With two to five players a board of this size became too crowded. The gameboard was enlarged onto a 2' x 4' pegboard with 1 1/2" squares. When the decision was made to convert the game into a solitaire game, such a large board was no longer necessary. The map, projected onto an 11" x 17" sheet of card-stock paper, was returned to its original size (16" x 8"). At the bottom of the gameboard, below the map, a score sheet was included so players could keep track of the number of moves it took to sail around the world.

The final version of the gameboard included the map (original size), a score sheet at the bottom with space for 12 games, a spinner, and a brief resume of the game's rules. The final dimensions of the gameboard were 19" x 13 1/2".

Spinner. In the original game, dice were used to determine the number of spaces a player was allowed to move on each turn. Two problems were encountered in using dice. First, students were so fascinated by dice that they soon began to distract from efficient play of the game. Second, the number of moves allowed by a die (1-6) meant too much emphasis was placed on chance. A player lucky enough to roll high numbers continually would win the game without learning

the currents. To diminish the role of chance, a chart was used to decrease the number of spaces that could be moved on each turn. For example, if a player roled a 1 or a 2, he could move one space on the gameboard-map. The chart proved to be confusing to students, so a spinner was developed. The face of the spinner was constructed to maximize the one- and two-space moves. By removing some of the chance element, increased importance was attached to a knowledge of currents and winds which now would determine who would be the successful sailors.

Ocean Cards

The cards were written using the information on ocean currents and winds in the Goode's World Atlas (1970). The major ocean currents were described on the cards as well as the major wind patterns. The main changes in the cards were: (1) a reduction in number from approximately 68 to 32 in order to avoid needless repetition and to make the deck of cards more manageable, (2) diagrams and maps were included on the cards in addition to a narrative description of sailing factors, to help the poor reader comprehend the information, (3) the size was increased from 1 1/2" by 2 1/2" to 3" x 5", (4) the cards were secured in an alphabetical order by means of a ring. In previous versions, unfastened cards quickly became disorganized and students spent long periods of time searching for the card corresponding to the square they had landed on.

Rules

The rules had to be re-written to accommodate the conversion of the game into a solitaire game. Also, the rules were shortened to

include just two sections. The first section was an introduction which described the real-life situation and stated the object of the game. The second section provided an example of how a hypothetical game might progress. Description of the game materials was incorporated throughout the two sections, i.e., as each piece of game equipment was mentioned, it was described. A shortened version of the rules, the sequence of play, was printed on the gameboard for students to consult. In the final version of the game, one of the rules stated that players would make notes of the ocean currents and winds that effected their ship. Previously it was only suggested that students do so.

Short History of the Programmed Text

The programmed text entitled "A Programmed Lesson Directions, Location, Ocean Currents and Winds" was written to serve as the comparative treatment in an experiment evlluating the simulation game "Sailing Around the World." Using the educational objectives of the game, a program was developed using Programmed Geography. by Cynthia D. Buchanan (New York: Macmillan, 1963) as a structural guide. From January of 1972 to May of 1972, the program was rewritten five times.

The first two revisions were made as a result of the independent critiques of the program by the developer's major professors, Dr. E. T. Keach, Jr., and Dr. M. J. Rice. Changes were made which increased the depth of the coverage on the ocean currents and wind section, and deleted some portions of the section on directions. Frames were added which introduced and summarized sections of the lesson.

The next two revisions in the lesson were initiated by joint sessions between the developer and two different fifth-grade boys who implemented the program. The major changes which resulted from the first session were a simplification of the directions for implementing the program, and an attempt to bring the vocabulary level of the lesson to a lower level. After the second trial of the program, with a fifth-grade boy, it was noted that additional frames were needed to consolidate learning so that the student would be able to recognize the patterns of the wind and ocean current

systems of the world, in addition to a factual knowledge of names, location, and directions of the winds and currents.

The program was revised for the final time following the pilot test of the experiment. The program administrator during the pilot test kept a list of problems encountered by the students who implemented the game. They use of a transparency on the overhead projector seemed to clarify all directional problems. The administrator observed that most of the students were working at the program and not looking ahead to copy answers. The changes after the pilot test incorporated mostly graphic changes.

A PROGRAMMED LESSON

ON

DIRECTIONS

LOCATION

OCEAN CURRENTS

AND

WINDS

Student's Name_____

INTRODUCTION

In today's lesson you will learn many of the things that explorers, like Columbus and Magellan, had to learn in order to sail their ships to various parts of the world. As you can tell by the title, the lesson will teach you about direction, location, ocean currents and winds. The ocean currents and the winds pushed their ships along. And they kept track of location and direction in order to guide their ships where they wanted to go. This information will also help you understand many kinds of social studies concepts.

This is an unusual kind of lesson called a programmed lesson. In this programmed lesson you will read sentences that will tell you about concepts such as: direction, location, ocean currents, and winds. As you read you will have questions to answer. By reading carefully and by answering all the questions you will learn a lot about these concepts.

The sentences and questions will be on the right-hand side of the page. The answers will be on the left-hand side of the page. Cover up the answers with the card your teacher gives you. After you read each sentence and question write in your answer in the space provided. Then move the card down so you can check your answer with the correct one. If your answer is correct go on to the next sentence and question. If your answer is wrong go back and see if you can find out why it was wrong, then go on to the next sentence and question.

As you can see it is possible to move the card and copy the answer. However, since you will not be graded on the answers you make on the program, you will probably learn more by trying to answer the questions on your own rather than copying.

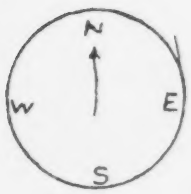
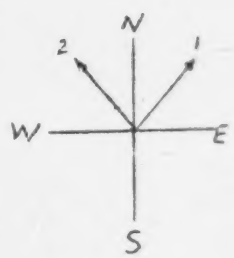
Important Things to Remember are:

(1) READ CAREFULLY
(2) TAKE YOUR TIME
(3) ANSWER EVERY QUESTION
(4) FILL IN THE BLANK AND THEN CHECK TO SEE IF IT IS CORRECT.

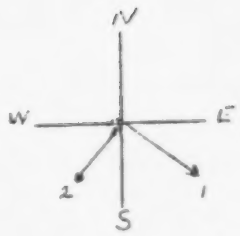
PART I: DIRECTION AND LOCATION

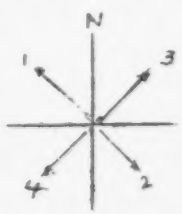
In the first section of the lesson you will learn about direction and location--two important concepts in geography.

located	1) When you are trying to find out where something is, we say you are trying to locate something. Location means where something is. If you walk down the hall, you will come to the cafeteria. The cafeteria is l_____ down the hall.
directions	2) In order to locate something for someone else, we have to give them directions. If someone asks you, "Where is the principal's office?" he is asking you for d_____ to the principal's office.
directions	3) You might say, "Go down the hall and turn left; it's the first door on your right." These are _____ to the principal's office.
sun sun	4) Inside the school you use words like hall, door, left, and right to give directions. Outdoors, we sometimes use other words to give directions. This morning on your way to school the sun was coming up. The _____ was rising in the east. At night the _____ sets in the west.
directions directions	5) East and west are directions. Besides east and west, two other _____ are north and south. East, west, north and south are _____.

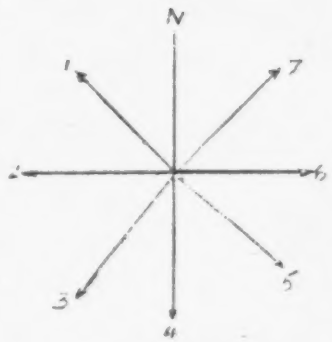
south	6) The figure at the right shows directions. The letters are labels that stand for directions. In the figure E stands for <u>east</u>. W stands for <u>west</u>. S stands for _____. 
north	7) In the figure, the arrow is pointing toward what direction? _____
south	8) In the figure to the right, arrow number 1 is pointing toward <u>W or west</u>. In which direction is arrow number 2 pointing? _____
	9) In the figure to the right, label the directions.
	10) In the figure to the right, label the directions.
west	11) Besides north, south, east, and _____, other directions can be identified.
east	12) In the figure to the right, arrow number 1 is between north and _____. We call this direction <u>northeast</u>. 
north west	13) Arrow number 2 is between _____ and west. We call this direction north_____.

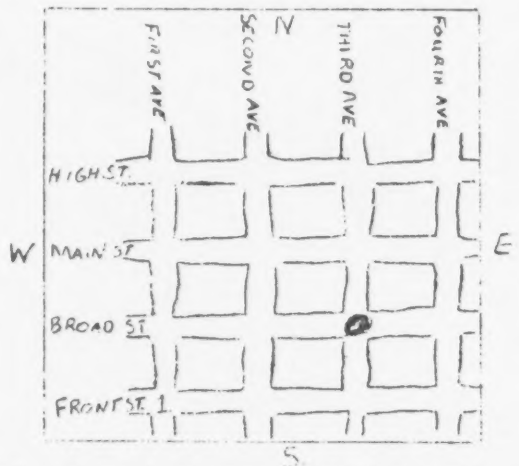
east south south	14) Arrow number 1 is between _____ and _____. We call this direction _____east.
vest southwest	15) Arrow number 2 is between south and _____. We call this direction_____.
northwest	USE THE FIGURE BELOW TO ANSWER THE FOLLOWING QUESTIONS. 16) Arrow number 1 is pointing _____.
southeast	17) Arrow number 2 is pointing _____.
northeast	18) Arrow number 3 is pointing _____.
southwest	19) Arrow number 4 is pointing _____.

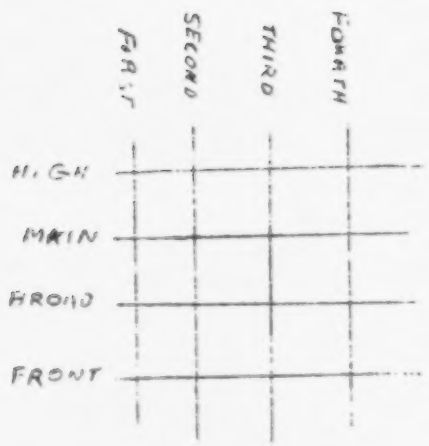


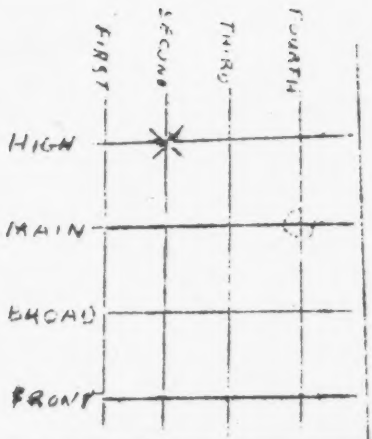


	USE THE FIGURE BELOW TO ANSWER THE FOLLOWING QUESTIONS.
northwest	20) Arrow number 1 is pointing _____.
west	21) Arrow number 2 is pointing _____.
southwest	22) Arrow number 3 is pointing _____.
south	23) Arrow number 4 is pointing _____.
southeast	24) Arrow number 5 is pointing _____.
east	25) Arrow number 6 is pointing _____.
northeast	26) Arrow number 7 is pointing _____.
directions	27) East, west, north and south are _____.
west	28) Directions like north, south, east, and _____ help us locate things.



west	29) Sometimes we can use streets to help us locate people and things. Below is a map of part of a town. On this map the avenues go north and south, the streets go east and _____.
Third Avenue	 30) If a friend of yours said he would meet you at Broad Street and Third Avenue, you could walk along Broad Street until you came to _____ _____ and there you would meet your friend. The dot on the map shows where you would meet.
Broad Third	31) The location of your meeting place is _____ Street and _____ Avenue.
Front Street First Avenue	32) Find the number 1 on the map. What is the location of the number 1? _____ _____ and _____ _____.





33) Use the map above to answer the next two questions.

The newspaper said two cars had an accident at High Street and Second Avenue. Put an X on the map where the accident took place.

- -

Main Street and Fourth Avenue is the location of a new stoplight. Draw a circle at the place where the new stoplight can be found.

SUMMARY - PART I

A) In this part of the lesson you have learned about direction and location. If you tell someone where you are you are telling your _____. (location/direction)

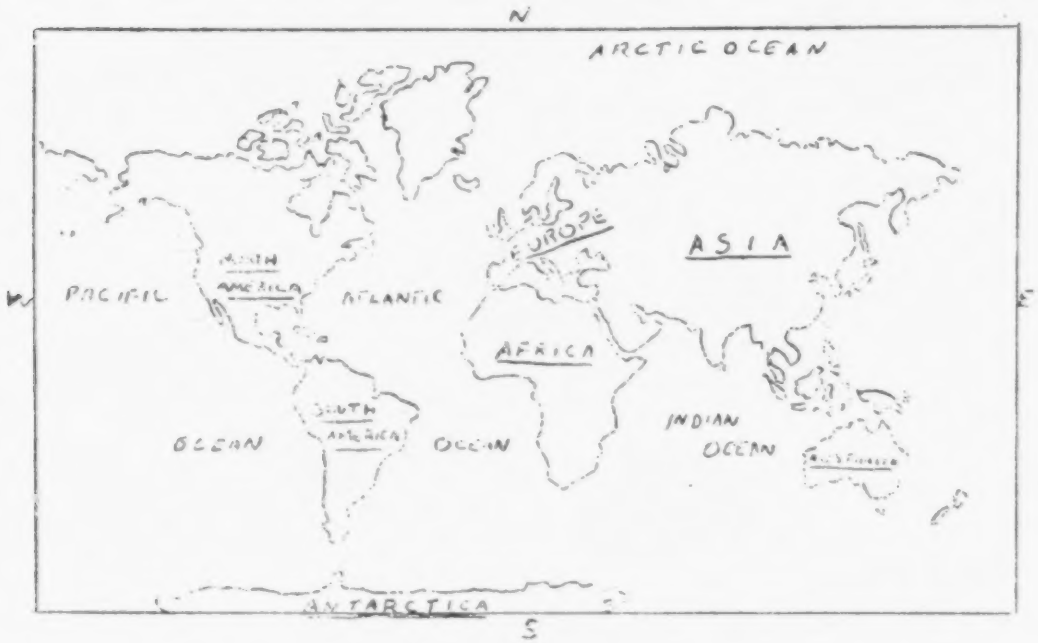
location

B) If you tell someone how to get to a place you are telling _____. (directions/locations)

directions

PART II: OCEAN CURRENTS

In this part of the lesson you will learn about the currents in the Atlantic Ocean, the Pacific Ocean and the Indian Ocean.



Antarctica
North America
South America
Europe
Africa
Asia
Australia

34) The map above shows the continents of the world. On the map the names of the continents are underlined. Can you list the continents of the world?

1. 4.
2. 5. 7.
3. 6.

water

35) All around the continents are large bodies of water called oceans. An ocean is a large body of _____.

Atlantic
Pacific
Arctic
Indian

36) On the map four oceans of the world are shown. List the oceans of the world.

1. 3.
2. 4.

water

37) The Atlantic Ocean is a large body of_____.

currents

38) The water in the ocean does not stand still. It moves from place to place. In an ocean, moving water is called an ocean current.

Water in the Atlantic Ocean often moves from one place to another place. The Atlantic Ocean has many ocean_____.

ocean currents	39) One of the maps that was given to you is a map of ocean currents of the Atlantic Ocean. (Map No. 1) Take it out now and put it in front of you. It will help you answer some of the questions on the next few pages. On the map the wide arrows show how the water in the Atlantic Ocean moves from place to place. The wide arrows show the o_____ c_____ in the Atlantic Ocean.
Atlantic	40) South of the United States and west of Cuba is a body of water called the Gulf of Mexico. Find it on the map. From the Gulf of Mexico, an ocean current flows in a northeast direction in the A_____ Ocean.
Mexico	41) The current in the Atlantic Ocean that begins in the Gulf of _____ is called the Gulf Stream.
Gulf Stream	42) The _____ _____ is a current that starts in the Gulf of Mexico.
3	43) On your map, an arrow shows how water flows from the Gulf of Mexico in a northeast direction across the Atlantic. The arrow number is _____.
Atlantic	44) In the northern part of the Atlantic Ocean, the ocean current that flows toward Europe is called the North Atlantic Drift. The North Atlantic Drift is an ocean current that flows across the northern part of the _____ Ocean.
North Atlantic Drift	45) The ocean current that flows across the northern part of the Atlantic Ocean toward Europe is called the _____ _____ _____.
1	46) On the map, which arrow stands for the current that flows across the northern part of the Atlantic Ocean toward Europe? The arrow number is _____.

Gulf Atlantic Ocean	47) The Gulf Stream got its name because it starts in the _____ of Mexico. The North Atlantic Drift got its name because it flows through the northern part of the _____ _____.
Africa	48) A third current got its name from a small group of islands called the Canary Islands. On the map you can see that the Canary Islands are located just off the coast of _____.
Canary	49) The ocean current that flows past the Canary Islands is called the Canaries Current. The Canaries Current flows past the C_____ Islands along the coast of Africa.
2	50) On the map the arrow that stands for the Canaries Current is arrow number _____.
west	51) The imaginary line that goes through the center of the map is called the equator. Find it on the map of the Atlantic Ocean. North of the equator an ocean current flows _____ across the Atlantic Ocean toward the Americas. This current is called the North Equatorial Current. north/south/east/west
North Equatorial Current	52) The ocean current that flows west across the Atlantic Ocean toward the Americas is called the _____ _____ _____.
4	53) On the map the arrow that stands for the North Equatorial Current, the current that flows across the Atlantic Ocean just north of the equator, is arrow number _____.

equator	54) On the map find the line that is called the equator. The _____ is the imaginary line that goes across the middle of the map.
west	55) In the Atlantic Ocean just south of the equator an ocean current flows _____ toward South America. This (north/south/east/west) current is called the South Equatorial Current.
South Equatorial Current	56) North of the equator the current that flows across the Atlantic is called the North Equatorial Current. South of the equator the current that flows west across the Atlantic is called the _____ _____ _____.
south	57) The South Equatorial Current got its name because it can be found just _____ of the equator.
5	58) On the map, which arrow stands for the ocean current just south of the equator, the South Equatorial Current. The arrow number is _____.
eastern	59) Find the continent of South America on the map. In the eastern part of South America you can see the country called Brazil. The ocean current in the Atlantic that flows south along the eastern coast of South America is called the Brazil Current. The Brazil Current flows south along the _____ coast of South America.
Brazil Current	60) The current in the Atlantic Ocean that flows south along the east coast of Brazil is called the _____ _____.
7	61) On the map the arrow that stands for the Brazil Current is arrow number ____.

west to east	62) In the southern part of the Altantic Ocean an ocean current flows from the southern tip of South America toward the southern tip of Africa. This current is called the West Wind Drift. The West Wind Drift is an ocean current that got its name because it flows in the same direction that the wind is blowing in that part of the world. The wind blows from the west toward the east, and the current goes from _____ to _____.
west	63) The West Wind Drift is named because it flows from _____ to east.
West Wind Drift	64) The ocean current in the southern part of the Atlantic Ocean that flows in the same direction as the west wind is called the _____ _____ _____.
8	65) On the map which arrow stands for the West Wind Drift? The arrow number is _____.
Gulf Brazil Benguela	66) As the West Wind Drift flows from the southern tip of South America toward the southern tip of Africa, part of the current branches off and flows north up the west coast of Africa. The rest of the current goes straight into the Indian Ocean. The ocean current in the Atlantic that flows north along the west coast of Africa is called the Benguela Current. The Gulf Stream was named after the _____ of Mexico. The Brazil Current was named after _____. The Benguela Current was named after a place in Africa called _____.
Benguela Current	67) The current in the Atlantic Ocean that flows north along the African coast is called the _____ _____.
6	68) On the map, which arrow stands for the Benguela Current? The arrow number is _____.
	69) Eight different currents in the Atlantic Ocean have been named. On the map of ocean currents of the Atlantic Ocean (Map No.1) write the names of the currents next to the proper arrows.

Australia	70) Take out the map that shows ocean currents in the Indian Ocean (Map No. 2). In the center of the map is the Indian Ocean. The wide arrows show the direction of the ocean currents in the Indian Ocean. West of the Indian Ocean is the continent of Africa. North of the Indian Ocean is the continent of Asia. East of the Indian Ocean is the continent of _____.
west	71) In the southern part of the Indian Ocean an ocean current flows from just south of Africa across the Indian Ocean south of Australia and on into the Pacific Ocean. This current is called the West Wind Drift. The West Wind Drift got its name because the ocean current is always flowing from the _____. (west/east)
West Wind Drift	72) The ocean current that flows right through the Indian Ocean from the Atlantic to the Pacific is the _____ _____ _____.
5	73) Which arrow stands for the ocean current in the Indian Ocean that is known as the West Wind Drift? Arrow _____.
west Australia	74) Find Australia on the map of the Indian Ocean. The current that flows along the west coast of Australia is called the West Australia Current. The West Australia Current got its name because it flows north along the _____ coast of _____.
West Australia Current	75) The part of the West Wind Drift that branches off and flows north along the west coast of Australia is the _____ _____ _____.
4	76) On the map of the Indian Ocean, which arrow stands for the West Australia Current. Arrow number_____.
Africa	77) On the map you can see that the equator passes through the Indian Ocean. Just south of the equator is an ocean current called the South Equatorial Current. The South Equatorial Current flows from east to west across the Indian Ocean toward what continent? _____
South Equatorial Current	78) In the Indian Ocean, the current just south of the equator is the _____ _____ _____.

equator	79) North of the equator an ocean current flows from east to west across the Indian Ocean. This current is called the North Equatorial Current. The North Equatorial Current was named because it flows in the Indian Ocean north of the _____.
North Equatorial Current	80) The ocean current north of the equator that flows toward Africa is called the _____ _____ _____.
3 1	81) On the map, which arrow stands for the South Equatorial Current? Arrow number _____. And which arrow stands for the North Equatorial Current? Arrow number _____.
Equatorial Current	82) As the South Equatorial Current flows toward Africa part of the current turns north and then flows back toward the east. This current is called the Equatorial Counter Current. The Equatorial Counter Current flows in the opposite direction from the South _____ _____.
west	83) North and south of the equator in the Indian Ocean, the currents flow from east to west. The counter current flows from _____ _____ to east.
Equatorial Counter Current	84) In the Indian Ocean the current between the North Equatorial Current and the South Equatorial Current is the _____ _____ _____.
2	85) Which arrow stands for the Equatorial Counter Current? Arrow number _____.
	86) Five different currents in the Indian Ocean have been named. On the map of ocean currents in the Indian Ocean (Map No. 2) write the name of the currents next to the proper arrows.

Australia	87) Now look at the map (Map No. 3) that shows the ocean currents in the Pacific Ocean, the largest ocean in the world. The Pacific Ocean touches the continents of South America, North America, Asia, and _____.
West Wind Drift	88) Find Australia on the map of the Pacific Ocean. South of Australia you can see an arrow that stands for an ocean current. This ocean current flows across the Pacific Ocean (from west to east) toward the southern tip of South America; it is called the West Wind Drift. The ocean current that flows across the Pacific toward the southern tip of South America is called the _____ _____ _____.
Pacific	89) The West Wind Drift is an ocean current in the Atlantic Ocean, in the Indian Ocean, and in the _____ Ocean.
West Wind Drift	90) The ocean current that flows across the Pacific Ocean south of Australia, south of South America, and on into the Atlantic Ocean is the _____ _____ _____.
7	91) Which arrow stands for the current that flows from west to east across the southern part of the Pacific Ocean? Arrow number _____.
South	92) On the west coast of South America find the country of Peru. The current that flows north along the coast of Peru is called the Peru Current. The Peru Current flows north toward the equator along the west coast of _____ America.
Peru Current	93) In the Pacific Ocean the current that flows toward the equator along South America's west coast is the _____ _____.
6	94) On the map of the Pacific Ocean, which arrow stands for the Peru Current? Arrow number _____.

South Equatorial Current	95) After flowing north along South America's coast the current in the Pacific turns and flows west. This current is just south of the equator and it is called the South Equatorial Current. Just as in the Atlantic and Indian Oceans, the current just south of the equator is called the _____ _____ _____.
westward	96) The South Equatorial Current flows in a _____ward (east/west) direction from South America across the Pacific Ocean.
4	97) On the map of the Pacific Ocean, which arrow stands for the South Equatorial Current? Arrow number _____.
east Australia	98) As the South Equatorial Current flows westward across the Pacific Ocean, a part of the current branches off and flows along the east coast of Australia. This current is called the East Australia Current. The East Australia Current flows south along the _____ (east/west) coast of _____ and then it mixes in with the West Wind Drift.
south	99) Off the east coast of Australia the current flows from north to _____.
5	100) Which arrow stands for the East Australia Current? Arrow number _____.
Equatorial Counter Current	101) Part of the South Equatorial Current branches off and become the East Australia Current. Another part of the South Equatorial Current turns north and then flows back in an eastward direction. This current is called the Equatorial Counter Current. The current in the Pacific that flows along the equator is called the _____ _____ _____.

Equatorial Counter Current	102) Just as in the Indian Ocean, the current located near the equator that flows from west to east is called the _____ _____ _____.
3	103) On the map which arrow stands for the Equatorial Counter Current? Arrow number _____.
Asia	104) North of the equator is another arrow that stands for an ocean current. This current is called the North Equatorial Current. The North Equatorial Current flows from east to west across the Pacific Ocean toward _____. (Asia/Australia/South America)
South Equatorial Current	105) The North Equatorial Current flows in the same direction (east to west) as another current in the Pacific Ocean. What other current in the Pacific flows from east to west? _____ _____ _____.
North Equatorial Current	106) The current in the Pacific Ocean, in the Indian Ocean and in the Atlantic Ocean that flows just north of the equtor is the _____ _____ _____.
2	107) Which arrow on the map stands for the North Equatorial Current? Arrow number _____.
east	108) Find the country of Japan on the map. An ocean current flows across the Pacific from Japan all the way to North America. This current is called the Japan Current. The Japan Current flows from west to _____ across the Pacific Ocean.
Japan	109) The Japan Current begins near the country of _____ and flows across the Pacific Ocean toward North America.

Japan Current	110) The current that flows across the Pacific Ocean from Asia to the west coast of North America is called the _____ C_____.
1	111) On the map, which arrow stands for the Japan Current? Arrow number _____.
	112) In the Pacific Ocean, seven ocean currents have been named. On the map of the ocean currents of the Pacific Ocean, write the names of the currents next to the proper arrows. (Use Map No. 3)
south	SUMMARY - PART II A) Before going on to Part III, stop and look over your maps of the Atlantic (Map No. 1), Indian (Map No. 2), and Pacific (Map No. 3) Oceans. The equator passes through all three oceans. In all three oceans the currents flow in <u>circles</u>. In the Atlantic Ocean and in the Pacific Ocean, the currents form two circles (See Map No. 1 and no. 3), one north of the equator and one _____ of the equator.
south	B) In the Indian Ocean the currents flow in a circle _____ of the equator. north/south/east/west

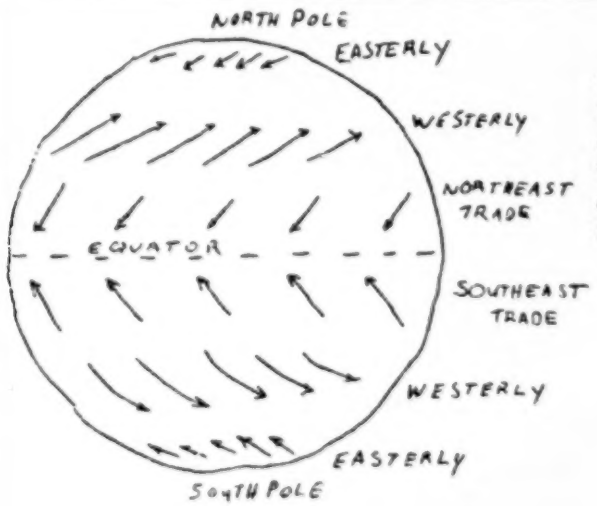
PART III: WINDS

In this section you will learn about the wind patterns in different parts of the world.

113) Water that moves from place to place is called a current. Air that moves from place to place is called WIND.

In the oceans of the world, moving water follows certain paths. Over the oceans of the world, wind (moving _____) also follows certain patterns.

air



The diagram at the left shows the earth's wind patterns. The arrows show the direction the wind is usually blowing.

114) The earth has three types of wind patterns. They are: easterly winds, westerly winds and trade winds. Winds are named for the direction from which they blow. Winds that blow from east to west are called _____ winds.

easterly

115) Winds that blow from west to east are called _____ winds.

westerly

116) Trade winds that blow from the northeast to the southwest are called _____ Trade Winds.
Northeast/Southwest

Northeast

117) Trade winds that blow from southeast to northwest are called _____ Trade Winds.

Southeast

easterly wind	118) Now look at map no. 4. The title of the map is WINDS. On this map the arrows show the direction that the wind usually blows. In the northern part of the map, find the large island named Greenland. The wind in this part of the world usually blows from east to west. This kind of wind is called an _____.
west	119) Find England on the map. The wind that blows across England comes from the _____. (east/west)
east	120) The wind in England usually blows from west to _____, this kind of wind is called a westerly wind.
northeast	121) Find the equator on the map. Wind blows toward the equator from two different directions. North of the equator the winds blow from the _____. (north/northeast/southwest)
southeast	122) South of the equator the wind blows from the _____. (south/southeast)
Northeast	123) The winds that blow from the northeast are called the _____ Trade Winds.
Southeast Trade	124) The winds that blow in toward the coast of Brazil are called the _____ _____ Winds.
west east	125) Find Antartica on the map. North of Antarctica the wind usually blows from _____ to _____. This wind is called a westerly wind.
westerly	126) The ocean current called the West Wind Drift flows in the same direction as this _____ wind. (westerly/easterly)

easterly	127) On the continent of Antarctica the wind usually blows from east to west. This kind of wind is called an _____ wind.
	SUMMARY - PART III
east	A) The winds of the earth follow three major patterns. Easterly winds near the poles, trade winds near the equator, and westerly winds in between. Near the North and South Poles you would expect to find the wind blowing from the _____ (direction).
easterly	B) This type of wind is called an _____ wind.
trade	C) North and south of the equator you would expect to find the _____ winds.
westerly	D) Between the easterly winds at the poles and the trade winds near the equator, you would expect to find the _____ winds.

CONCLUSION: In this programmed lesson, you have learned how to tell directions and how to locate places. You have also learned about the ocean currents and winds of the world. This information will help you understand many other concepts in geography.